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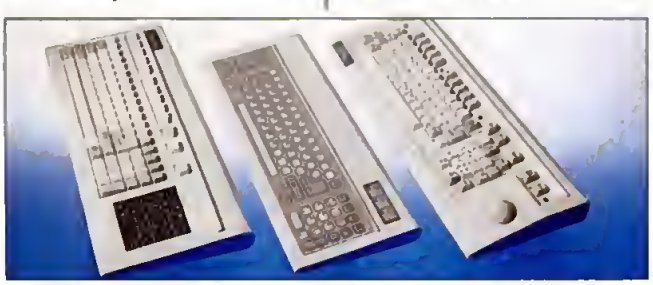

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Cover Photograph:
Roberto Brosan

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Hard disk users know the scenario. You type DIR and 300 files scroll by with strange names like KY_ZOOT3.SW! and JN86HQS5.HOT. One is the report from last year that you urgently need—but which one? The inscrutable filenames don't help, and as you laboriously use the DOS TYPE command or your word processor to display their contents, you realize that what you really ought to do is delete, rename, or move most of them. But that would take hours.

Unless, of course, you have *PC Magazine*'s wonderful DR.COM handy. One of our goals is to help readers work faster, smarter, and better. We cram every Productivity section with ingenious tips, timesaving techniques, and powerful free programs. This issue offers what many of us here feel is the most useful free utility we've ever published: Michael J. Mefford's dazzling DR.COM (so named since you'll use it instead of DIR). DR does just about everything DOS doesn't. For details, see "Doing What DIR Doesn't," page 437.

Contributing editor Mefford (pictured above) writes his programs from an office nestled in a thick stand of Oregon pines overlooking the wide sandy coast. He's been cranking out assembly language code for the back of the magazine 16 hours a day, seven days a week. Each issue we ask Michael, and our other programming gurus like Jeff Prosise, to create some of the most compact, capable little utilities available. And we think they succeed. If you haven't yet tried them, DR is a terrific place to start.

While our programming utilities give you DOS alternatives, our cover story gives you an in-depth look at the newest alternatives to the keyboard. Currently 8 to 10 percent of all PC users have a mouse, light pen, trackball, touch-screen, tablet, or specialized keyboard. The most widely used of these products—mice—already work with such mainstream applications as word processors and spreadsheets. And if you want to use desktop publishing, CAD, drawing, or painting packages efficiently, you'll find these devices particularly interesting. Look for reviews of 36 of these alternate input devices starting on page 95.

Elsewhere in this issue, we've found that slick newcomers are giving our old favorites *The Norton Utilities* and Borland's *SideKick* a run for their money. While *Norton* once ruled the file recovery roost, several competitors have caught up and have done even better with some forms of file recovery—see "Back from the Brink: File Recovery Software," page 381. Similarly, in "TSR Desktop Organizers: More Features, Fewer Conflicts," page 205, we've found that *SideKick*'s position may be usurped.

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*PC's Limited 386 Benchmark Study is available upon written request

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The 286[8] EGA Color System

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The above system with the following substitutions.

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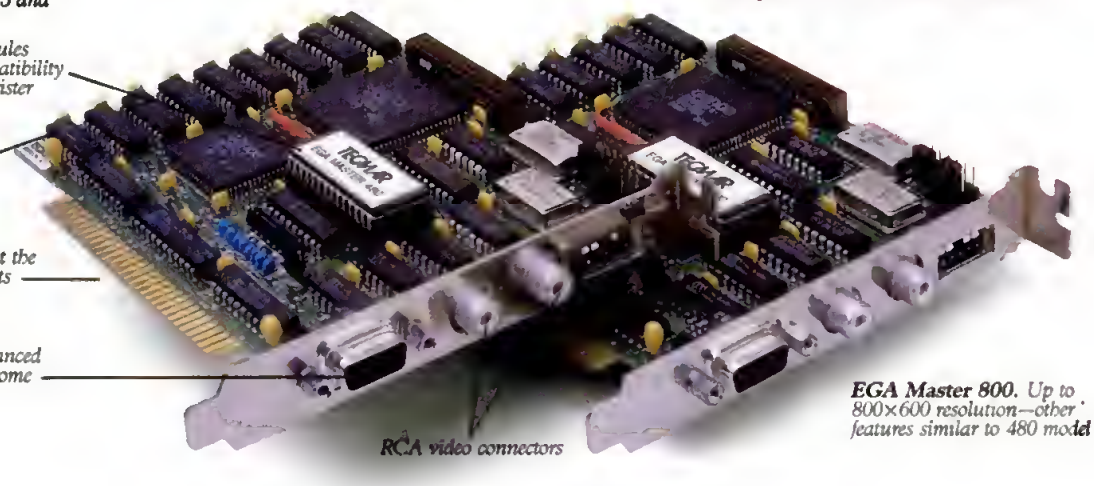

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EGA Master 480	•	•	•	•	•	•		
EGA Master	•			•				
Graphics Master	•		•		•		•	
MG1000	•	•						
M500	•							

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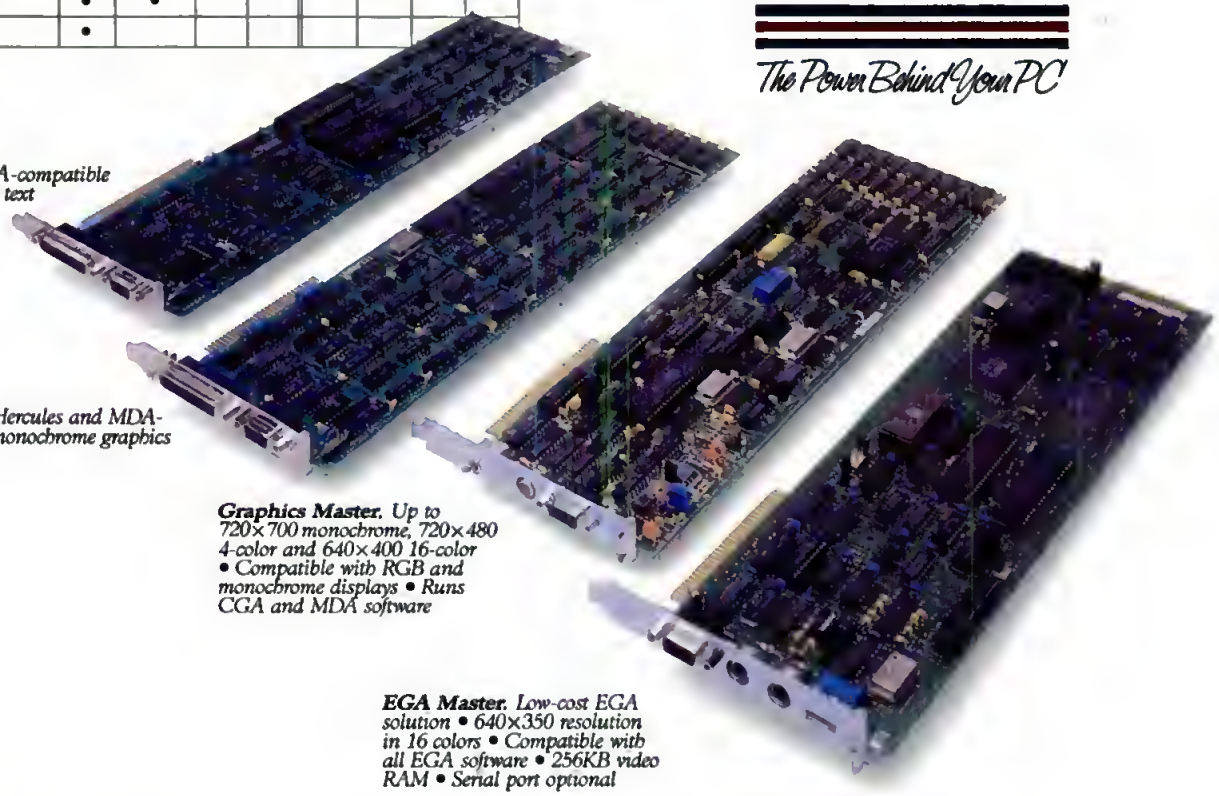

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*PC Magazine Editor's Choice, August 1986

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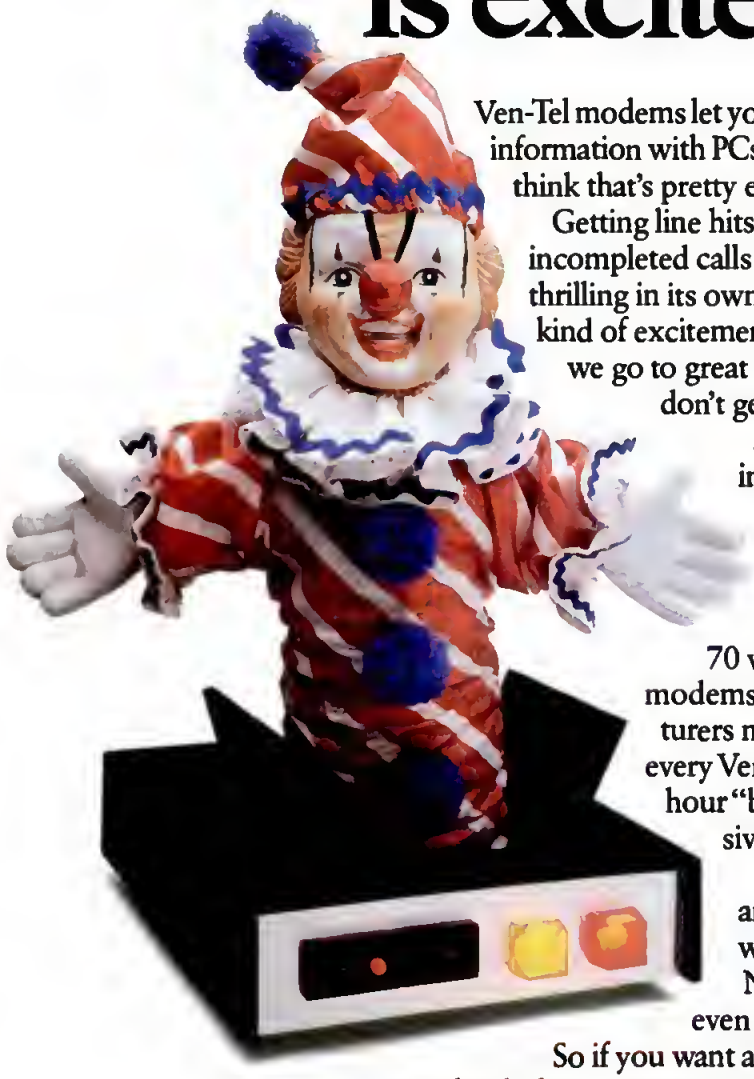
CIRCLE 237 ON READER SERVICE CARD

The last thing you want from your modem is excitement.



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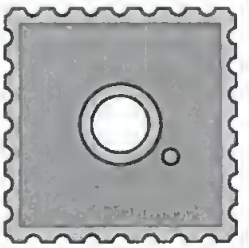
LETTERS TO PC MAGAZINE



WANTED: MORE WRITERS

The recent appearance of well-organized, readable documentation cited by Jim Seymour (Jim Seymour, *PC Magazine*, Volume 6 Number 9) results from the software industry's growing awareness that writers, and not programmers, should write documentation. Writers have the necessary skills for communicating with people, which are quite different from those needed for communicating with machines. In addition, writers are more likely than programmers to see software from the user's point of view and to anticipate his questions and concerns. The result: good documentation that reduces the amount of time and money spent on fielding calls from baffled users.

Cheryl Morrison
President, DocuClear
New York, New York

A SOLE OF THE TIMES

In reference to Stephen Manes's very amusing column about computerized running shoes (Stephen Manes, *PC Magazine*, Volume 6 Number 7), here is a definition of computerized running shoes at tryouts for a running competition: These are the soles that time men's tries.

Leslie A. Watson
Annandale, Virginia

GOOD INTENTIONS

Regarding your bit of humor about the glossary entry for "endless loop" in Ashton-Tate's *Advanced Programmer's Guide* (First Looks, *PC Magazine*, Volume 6 Number 8), are you so witless as to think these entries are really mistakes? That is your implication, since the notice is on a page that pokes fun at error-ridden ads and computer press typos.

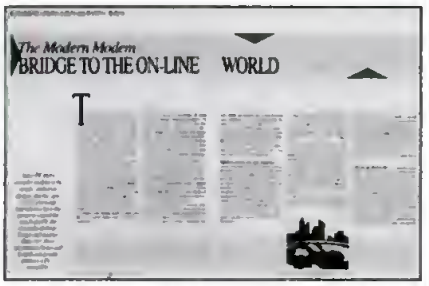
To some of us, it is obvious that the people who put together the *Advanced Programmer's Guide* are working on a different level than those at the *Buffalo News*, COMB mail-order catalog, or *PC Magazine*, for that matter.

Ed Boggan
Atlanta, Georgia

Bill Howard replies:
The common thread in the Communiqués is humor. Some Communiqués celebrate well-executed intentional humor; others point out unintentional gaffes. Until this letter arrived, we assumed most readers were sharp enough to tell the difference.

SOME DISASSEMBLING REQUIRED

I can imagine John Edwards's angst in being unable to solve the cosmic mystery of disassembling a U.S. Robotics Courier modem ("The Modem Modem: Bridge to the On-line World," *PC Magazine*, Volume 6 Number 9). Take heart, John. The answer is just a toll-free call away. In fact,



most of our customers are clever enough to use that number; it's printed right on the bottom of the modem case.

For the insatiably curious out there in magazine land, here's the big secret: peel the back two rubber feet off the bottom of the Courier case. Eureka! You'll find a screw beneath each foot (they've been hiding there all along). Unscrew them. Then lift the volume control knob off its sliding switch. Now separate the bottom of the case from the top. That's all there is to it. (John, you may want to perform this operation under adult supervision.)

Mark Smith
U.S. Robotics Inc.
Skokie, Illinois

A BASIC DIFFERENCE IN SPEED

I offer you my sincerest condolences on the loss you have recently suffered. The back-to-back articles by Ethan Winer, first praising QuickBASIC's support for the 8087 math coprocessors and then damning it for not supporting the chip, is a tell-tale sign that the author is not operating on all his chips and should probably have his parity checked (PC Lab Notes, *PC Magazine*, Volume 6 Number 9).

While Borland offers a nifty product, I think the chart on page 34 of that same issue, which shows Microsoft's QuickBASIC 3.0 to be almost 300 percent faster than Borland's Turbo BASIC without an 8087, says it all (First Looks, *PC Magazine*, Volume 6 Number 9). With so comparatively few 8087s installed, I think I (and most others) will stay with Microsoft.

Peter A. Westcott
La Mirada, California

Ethan Winer replies:
Deadlines being what they are, it isn't always possible to get the latest facts into print. In this case, the conflicting reports were written 2 months apart. However, you may be interested to know I had my parity checked last week, and it is even.

As you observed, QuickBASIC is much faster than Turbo BASIC without an 8087, because Turbo emulates the device in soft-

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NEW RELEASES/UPDATES

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[2] **COMM 1a,b**—(2 disks) Version 2 4 of the ever-popular Qmodem comm program
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☐ **EDUCATION 5**—Learn Origami, the Japanese art of paper folding Color required
[2] **FINANCES 3a,b**—(2 disks) Express Calc 3 12 a powerful spreadsheet program
☐ **GAMES 6**—Striker helicopter attack, and Risk world domination Color required
☐ **GAMES 9**—EGARisk, the game of world domination in very high resolution EGA required
☐ **GAMES 10**—Solitaire, Teed-Off golfing, and Sailing in the Bermuda triangle Color required
☐ **GAMES 12**—MyChess (9 levels), Backgammon, and Wheel of Fortune Color not required
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[2] **INFO 2a,b**—(2 disks) Zip-Phone, national areacode/ prefix to zip-code cross reference
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CIRCLE 302 ON READER SERVICE CARD

LETTERS

ware to maintain the same accuracy. However, the 8087 version of QB3 *suffers the same loss of speed for the same reason. (Though Microsoft offers two versions so you can choose whichever is more important to your application.)*

A BIT OF ESP

Like many other *PC Magazine* readers, I find your publication to be extremely useful in many ways. Not the least is the uncanny way in which your contributors and editors seem to read my mind. Often I've undertaken a research contract for a client or have defined an area of interest for further study, and, like magic, the next issue of *PC Magazine* has an article or sidebar that matches my requirements almost perfectly. Thank you for that little bit of ESP.

Ken MacKenzie
Calgary, Alberta
Canada

METRO MEMORY

Based on Bill Machrone's very positive appraisal of Lotus's new *Metro* program (First Looks, *PC Magazine*, Volume 6 Number 4), I rushed out and bought it as soon as it was available. Boy, was I in for a shock.

Metro comes configured to use 120K of lower 640K RAM. The minimum it will allow you to assign to it is 80K, but this is just Lotus's little joke on us, since *Metro* won't do a thing with 80K—you really need closer to 180K to do anything useful. *Metro* can't make use of expanded or extended memory, nor can it effectively use a RAMdisk.

Possibly the best (or worst) part of the program is that it doesn't keep its modules in memory; whenever you call up applications or change them, there is heavy disk activity and thus delays. It's unbelievable. Don't developers ever use the machines they design the software for?

Bob Kertesz
Los Angeles, California

Bill Machrone replies:
Most people don't come close to using the 640K in their machines, yet they resent every byte accessory programs take. True, Metro *is hungrier than most, but a task-swapping version of the program is due out shortly.*

MAKING CONNECTIONS

I am writing in reference to "Making Connections: 13 LANs in Perspective" (*PC Magazine*, Volume 6 Number 8), in which you made the following statement about Gateway Communications' G/NET: "On the downside, under heavy (but realistic) workload, G/NET was the slowest network tested."

In fact, according to the PC Labs benchmark test results that appeared in that issue, G/NET's average standing out of the field of 16 LANs tested in the three tests was eighth—that is hardly the slowest network tested.

In addition, the G/NET LAN that is referenced in your reports was originally tested running *NetWare* 1.02, while the other LANs tested ran the upgraded, and faster, 2.0 version. The reason is that during our in-house testing process we found a number of bugs in *NetWare* 2.0 and delayed release with that version until they were fixed.

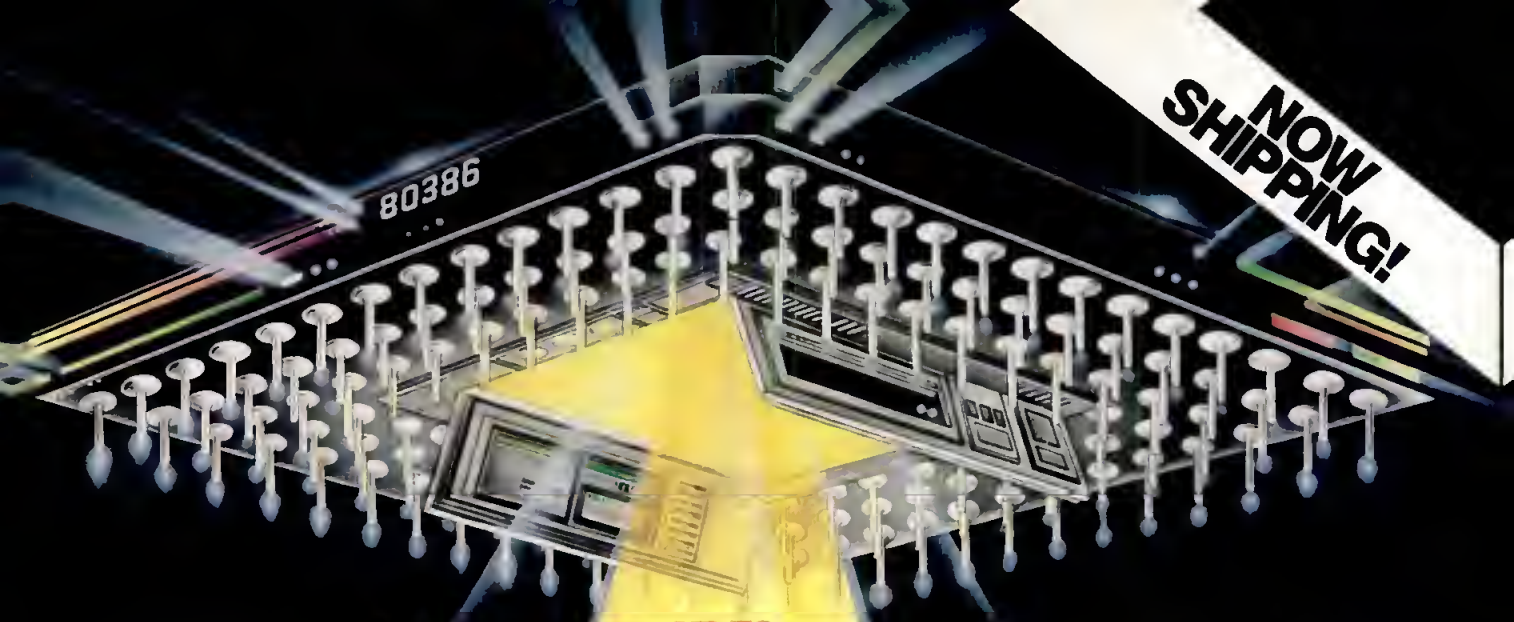
Bradley Morse
Gateway Communications Inc.
Irvine, California

Editor replies:
According to the PC Labs benchmark tests that were published in that issue, Gateway's G/NET did indeed have an average ranking for the three tests of eighth. This placed it in the middle of the pack, not last. We did misstate the ranking in the text. PC Magazine *regrets the error. We would also welcome the opportunity to look at the new version of G/NET at a future date.*

A LOOK AT LASERS

The complexities of laser printers and their cousins, the photocopiers, escape even the most technically minded outside the immediate field. Therefore I would like to correct several statements Alfred Poor made in the laser printer roundup ("Laser Printer Technology: Great Performance for Under $3,000," *PC Magazine*, Volume 6 Number 8).

The laser beam does not charge the photoconductor drum, as Mr. Poor and so



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■ LETTERS

many others have stated. The photoconductor drum is charged by the primary corona, a very fine wire that runs parallel to the drum with a voltage of 6,000 but at a very low current about a centimeter above it. The charge is passed to the drum by the corona effect. In a copier, the drum is then exposed to the image and, in the areas where light strikes the drum, the charge is reduced proportionally. Then an oppositely charged toner is applied to the drum and adheres to the areas that still have a charge (the dark areas).

A laser printer works slightly differently. To save wear, the laser exposes the dark areas of what is to be the finished product; then a toner is applied, adhering only to the areas that the laser exposed.

I would also like to note that Mr. Poor's admiration of Ricoh-engine printers over the Canon is obvious and out of place in a reportorial piece. It appears he either works for Ricoh or got his information from some behind-the-scenes gossip. Of all the things he said about both products, the only thing he got right was that the Ricoh engine makes a better black.

For example, the Canon, like most copiers introduced in the last 7 years, uses a seamless photoconductor drum with a circumference smaller than the maximum copy size. Also, it does not take two people to carry the Canon. I have carried a Canon laser printer many times by myself, and I am no Charles Atlas.

Tom Stearns
Salt Lake City, Utah

Alfred Poor replies:
Mr. Stearns is correct that other laser and copy engines use a seamless photoconductor with a circumference smaller than that of the page length, and I appreciate the errors being noted. The other "inaccuracies" are not as clear. While it is not as accurate to state that the laser charges the drum (it reduces the charge), the overall concept is clear without getting too technical. As for the weight of the original Canon engine, I too have carried one by myself but would join Hewlett-Packard and other laser printer manufacturers in their written recommendation that at least two people do it.

Until the advent of the new Canon engine (which I did not see before submitting the manuscript for publication), there was no engine on the market that could approach the new Ricoh engine for print quality, weight, size, or price. It is slower, but four out of five isn't too bad, and besides, the actual per-page timings were clearly reported elsewhere in the article.

The description of the HP Laserjet Series II (First Looks, *PC Magazine*, Volume 6 Number 7) claims there is no software in existence that can take advantage of the second font cartridge. In fact, software commands identify a font by its unique ID; identifying the slot number is not necessary. Thus, all software will work with cartridges in any slot. By carefully merging two of the .PRD files supplied with *Microsoft Word*, for example, it is possible to create a two-cartridge .PRD file.

Pulak Dutta
Evanston, Illinois

Bill Machrone replies:
True, each font has a unique ID, but the printer also provides cartridge-related font codes. You reference them from the front panel and in a number of the escape sequences. They are convenient, easy to understand, and so far unsupported.

FLAT-OUT WRONG?

John C. Dvorak seems to be quite a bit off base in his February 10 column, "IBM's PC II: Fiasco in Wonderland" (*PC Magazine*, Volume 6 Number 3). In the article he attempted to label the PC-XT Model 286 as "IBM's long-awaited PC II." On that shaky base, he went on to allege big blunders by IBM, predict IBM marketing screw-ups, and claim that it's obvious IBM will no longer lead the way in PCs.

Given the announcement of the IBM Personal System/2, I feel that Mr. Dvorak is predicting death prematurely and is flat-out wrong.

Frank G. Golazeski
Wappingers Falls, New York

Mr. Dvorak is saddened by this criticism. Never before, he says, has anyone mounted such a vehement personal attack on his reputation and insight. Therefore, Mr. Dvorak says, if all the analyses and predictions do not prove to be 100 percent accurate, he will shred the column, mix it in

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■ LETTERS

brownie dough, and eat it. If the predictions do come true, as expected, Mr. Dvorak will gladly send the brownie to Mr. Golazeski so he can eat it.

SHAREWARE NO MORE

After reading about *Label Master* in your article "Special Delivery: Mailing-List Managers" (*PC Magazine*, Volume 6 Number 6), I decided to order it. Boy, was I surprised to learn from RKS Associates that not only is *Label Master* no longer a shareware product, but the price has also gone up from $35 to $49 "because of the tremendous demand" your magazine has created! The people at RKS told me the $14 price increase handles packaging. I wonder how they shipped it before?

Roger Johnson
Carmel, Indiana

A REAL JEWEL

You have recently acquired a veritable jewel—Mr. Jeff Prosise. Please don't let him get away.

T.R. Carpenter
Clinton, Arizona

BACKUP TOOLS ARE BETTER

I must comment on your review of Design Software's *DSBackup Plus* in the article "Better Tools for Backup" (*PC Magazine*, Volume 6 Number 8). I have been using *DSBackup Plus* since the product first came out 2 years ago. Contrary to the reviewer's experience, I have never had a situation arise where the program did not perform as expected. I have nothing but high praise for this product.

Anthony Marinelli
Hyannis, Massachusetts

I work quite a bit with *Fastback* and have found the program fails to install on about one-third of the PCs I work with, including IBM's. When a machine fails the DMA test of *Fastback*, the program goes into slow mode, which abrogates its usefulness. With AT&T PCs, the program fails if you try to reuse your *Fastback*-formatted disk set for a different backup, making a restore impossible.

A machine's individual characteristics (even within the same brand and model) may contribute to the success or failure of a product. Potential buyers should be able to try the product on their PCs and return or exchange it if it does not function properly. In the case of *PC Magazine* ("Better Tools for Backup"), the reviewer should have tested *Fastback* on more than one machine.

John A. Plozay
Aromas, California

HOOEY, DOOEY, AND LOOEY

I have to disagree with the letter from Richard M. Johnstone of North Little Rock, Arkansas (Letters to *PC Magazine*, Volume 6 Number 9). The main reason I like *PC Magazine* is the contemporary style of writing. It reads the way I talk, and that helps translate complicated ideas and themes into easily understood terms. If the magazine were too high-brow, I wouldn't buy it. So go ahead, guys, throw in a hooey, dooey, and looey for good measure once in a while!

Mike Evans
Columbus, Ohio

CORRECTIONS/AMPLIFICATIONS

The IBM Memory Expansion Adapter (First Looks, *PC Magazine*, Volume 6 Number 5, page 44) costs $595 with 512K RAM or $749 with 1,024K. The 1-megabyte memory module kit is $349, and the 512K memory module kit costs $165.

The Sony Multiscan CPD-1302 monitor does have analog and separate sync input ("Behind the Screens: EGA and Multiscan Monitors," *PC Magazine*, Volume 6 Number 6).

HOW TO WRITE TO PC MAGAZINE

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☐ #480 PC Outline. Comparable to thinktank. Outlining helps you to arrange and re-arrange items by using different categories of classification ... $6

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☐ #133 ULTRA UTILITIES. Lost files may be recovered using this program. Features include file review and modification ... $6

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☐ #523 SIDEWRITER. Text files may be printed sideways with this useful program ... $6

☐ #558 PC PROMPT. Memory resident program that has HELP commands on an online mode. Provides syntax of most DOS commands ... $6

☐ #608 AUTOMENU. Programs are easily accessible with this program. Batch files and DOS commands are easily executed by "point and pick" ... $6

☐ #728, #729 HOMEBASE. The next generation in a desktop organizer. Features a calculator ... $12

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10 BIG REASONS IT'S TIME YOU CHANGED YOUR EDITOR TO BRIEF

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2 OUR ENTHUSIASM. While we do not publish BRIEF we wish we did. We sell so many BRIEFs that we've been advertising it non-stop since it was introduced two years ago. We're not alone in our enthusiasm. There is no end of accolades from other admirers:

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"Overall, BRIEF is an excellent and efficient editor with capabilities that are truly useful. If you're a serious programmer or developer of commercial applications, the BRIEF/dBRIEF package is one of the best investments you can make." *PC Magazine*, 7/86

"Every time I've mentioned text editors I've got a raft of mail urging me to try Brief. Now that I've tried it I see why. It has windows—boy, does it ever have windows! It will do just about anything you want it to. Look no further. I recommended." Jerry Pournelle, *Byte* 12/86

Best editor of 10 compared
Dr. Dobb's Software Tools

3 WINDOWS ON THE WORLD. Why the excitement? First, BRIEF's architecture. *Any number of files* of virtually any length can be open. (Start BRIEF with "*.*" to prove it.) Open as many tiled windows as fit the screen—over/under and side-by-side—to work on any of your files. Open, close, and resize windows as you go. In each window, full screen or tiny, all editing techniques are at hand—high-speed cursoring, paging up and down, horizontal scrolling, optional word wrap. Load the same file in any number of windows to view different areas simultaneously. A change in one changes all. Cut and paste text blocks between windows and files, or into buffers for later recall. All files stay in memory, so you can always go back to snip some more.

4 WHOLLY MACROS. Much of BRIEF was written in its own macro language. It is that powerful! The language and its compiler come with every copy, as do many standard macros, with source code for learning by example. It is a complete language with conditionals, loops, recursion, global and local variables, even data types. It can control files, windows, and the keyboard. It has structure, 32-character variable names, and—not at all like 1-2-3®'s cuneiform—is entirely readable, like a hybrid of LISP and C. With it you can develop a library of routines to power BRIEF your way.

5 UNDO. NOT UN-DELETE. Don't confuse the two. BRIEF doesn't just keep snapshots of recent deletions should you want to pick them up from the cutting room floor. It can reel the whole film backward undoing any command that affected the cursor or the text. Watch it undo a global replace, for example. Uncanny. It can back up 300 times, all the way to the beginning of a session. "Works like a dream", said *The C Journal*.

6 SHELL GAMES. Leave BRIEF, run your compiler, print out the error messages, load up BRIEF again? No way! Run your compiler from *inside* BRIEF*. It will point to each error line in your source program, still loaded in memory, for immediate editing. You don't have to leave BRIEF to use DOS either. BRIEF disappears from the screen to get out of your way, but say bye to DOS and BRIEF pops back to the screen, as do all the files you were working on.

7 KEY WHIZ. You can reassign BRIEF's command keyhits to whatever keys you're used to, even your old editor's, so you don't have to send your fingers back to school. Macro execution can be assigned to single keys. Or you can tell BRIEF to listen while you tap out a complex routine. It will save and playback faithfully, a shortcut macro without a single line of coding.

8 MULTI-LINGUAL. BRIEF's macro language is perfect for writing formatters for your language which indent, match up parentheses and brackets, and set up statement templates for fill-in. BRIEF comes with C language support already built in. Others have written macros to format Pascal, BASIC, LISP, Prolog, FORTRAN.

9 QUICKER PICKER-UPPER. Looking for something? BRIEF has full UNIX®-like expression search tools to forage and find and fix any file in memory. Literal strings with wildcards and "?" character masking, sure. But also indifference to case or intervening characters, [aeiou] to match all vowels, or [~aeiou] to match anything *but* vowels, [a-f,l-m] to match character ranges, beginning or end of line searches, even multiple choice pattern matching and replacement.

10 REASONS 11 THROUGH 20: **11.** BRIEF comes with a color option. You can select your own color scheme anytime. **12.** It supports EGA's 43-line mode and can display up to 128 lines long. **13.** Full 8-bit ASCII display; the whole character set can show on screen. **14.** Full path support. **15.** Command line start-up flags to modify BRIEF's behavior, change a path name, or run a macro: for example "wp" which turns BRIEF into a word processor with wraparound and margin setting. **16.** Automatic file save during idle moments. **17.** Compatibility with most stay-resident programs (like Sidekick™), multi-taskers (like Microsoft Windows™), and networks. **18.** A bulletin board with public domain macros contributed by a mushrooming cult of macromancers. **19.** No copy protection. **20.** Context sensitive help, and phone support from the publisher.

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"Simply marvelous programming environment for writing and editing dBASE programs", *PC Magazine*, 7/86. Source code included!

Requires BRIEF 1.32 or later and 384k. 512k to run dBASE within dBRIEF. 640k and harddisk recommended.

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MICROSOFT C 4.0

A Great C Battle Rages and You're Winning

It bundles a source debugger and a "make", and sports a "huge" memory model permitting single data objects larger than 64k, but what's really impressive about Microsoft C are the benchmarks reported in Dr. Dobb's. Microsoft runs away from a field of 17 winning 11 of 27 benchmarks.

The CodeView™ debugger uses windows to show everything on one screen: source alongside disassembled object, variables, stack and registers. Drop down windows obviate learning of commands. "A source-level debugger that puts the rest to shame" said Dobb's.

Microsoft C has five memory models for code and data, plus non-library support for another thirteen, and boasts alternate math packages for speed versus accuracy, with or without 8087/80287 chips.

Both linker and library manager are part of the package, as is the "make", which knows how to rebuild any size project by compiling only elements which have changed.

It is reportedly used by Lotus, Ashton-Tate and, fittingly, Microsoft itself to develop Windows. Dobb's calls it "the best MS-DOS C development environment value today [for] virtually any kind of program conceivable." 320k suggested.

Ask for	List	PC Brand
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	List	PC Brand
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Panel Plus will operate in graphics mode via interfaces to graphics products it supports. Handles EGA's 43 line screen. Adapts to various keyboards screens, operating systems. Major tool for the serious developer. List **$495**, PC Brand **$395**

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Arity Combination Package	1095	978
Expert System Development Pkg	295	229
Fils Interchange Toolkit	50	44
PROLOG Compiler & Interpreter	650	569
Screen Design Toolkit	50	44
SOL Development Package	295	229
Arity PROLOG Interpreter	295	229
Arity Standard Prolog	95	77
AI·SXPERT SYSTEMS		
Autointelligence *by Intelligence Were*	990	739
Experteach II *by Intelligence Wsre*	475	339
EXSYS *Development Software by EXSYS.*	395	309
EXSYS Runtime System	600	469
Insight 2+ *by Level Five Research*	485	378
Intelligence/Compiler *IntelligenceWare*	990	739
AI·LISP LANGUAGE		
IQCLISP *by Integral Quality*	300	Call
IQLISP *by Integral Quality*	270	Call
Microsoft LISP *Common LISP*	250	189
TransLISP *from Solution Systems*	95	Call
TransLISP PLUS *from Solution Systems*	195	Call
AI·PROLOG LANGUAGE		
APT *Active Prolog Tutor from Solution Sys*	65	Call
MPROLOG Language Primer *LOGICWARE*	50	45
MPROLOG P500 *by LOGICWARE*	495	395
MPROLOG P550 *by LOGICWARE*	220	175
Prolog-86 *from Solution Systems*	125	Call
Prolog-86 Plus *from Solution Systems*	250	Call
Turbo PROLOG *by Borland Int'l*	100	63
Turbo PROLOG Toolbox *by Borland Int'l*	100	64
ASSEMBLERS S DEBUGGERS		
Advanced Trace-86 *Morgan Debugger*	175	119
C·Sprite Debugger *by Lattice, source level*	175	139
Microsoft Macro Assembler *with Utilities*	150	109
PASM86 *by Phoenix, Macro Assembler*	195	125
Periscope I Debugger *The Periscope Co*	345	289
Periscope II *with NMI Breakout Switch*	175	139
Periscope II·X *software only*	145	105
Periscope III *with Advanced Board New*	995	Call
SASIC LANGUAGE		
Microsoft BASIC Interpreter *for XENIX*	350	295
Microsoft QuickBASIC Compiler *3.0*	99	79
BORLAND PRODUCTS		
Reflex & Reflex Workshop	200	129
Reflex *Data Base System*	150	89
Reflex Workshop	70	45
Turbo Basic *New*	100	64
Turbo C Compiler *New*	100	64
Turbo Lightning	100	64
Turbo Pascal & Tutor *New*	125	85
Turbo Pascal with 8087 & BCD	100	64
Turbo PROLOG Compiler	100	63
Turbo PROLOG Toolbox	100	64
Turbo Tutor	40	28
C COMPILERS		
C86 PLUS *by Compiler Innovations New*	497	397
Lattice C Compiler *from Lattice*	500	299
Let's C Compiler *by Mark Williams with CSD Source Level Debugger*	75	55
	125	90
MWC-86: Mark Williams C Development	495	369
Microsoft C Compiler *4.0*	450	295
Turbo C Compiler *by Borland New*	100	64
C INTERPRETERS		
C·Terp *by Gimpel Software*	300	249
Instant C *by Rational Systems*	500	395
Interactive-C *by IMPACC with debugging*	249	219
RUN/C Professional *from Lifeboat*	250	195
COMMUNICATIONS		
Asynch Manager *by Blaise, for C or Pascal*	175	117
Greenleaf Communications *by Greenleaf*	185	139
C UTILITY LIBRARIES		
Blaise C Tools Plus	175	117
Blaise C Tools	125	84
Blaise C Tools 2	100	67
C Food Smorgasbord *by Lattice*	150	109
C Utility Library *by Essential, 300 functions*	185	139
Greenleaf Functions *by Greenleaf Software*	185	139
COBOL LANGUAGE		
RM/COBOL *see Ryan McFarland Prod*		
Microsoft COBOL Compiler	700	499
Microsoft COBOL Compiler *for XENIX*	995	795
Micro Focus COBOL *see Micro Focus Prod*		
dBASE SUPPORT		
BRIEF/dBRIEF... *Brief for DBASE III*	275	Call
CLIPPER... *from Nantucket*	695	Call
McMAX... *dBASE for MAC from Nantucket*	295	Call
dBx... *dBASE to C Translator by DESKTOP AI*	350	299
with Library Source Code	550	469
with Full Source Code	1000	855
dBC *from Lattice, maintains DBASE files with source*	250	195
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with source	1500	1185
DEVELOPMENT TOOLS		
BASTOC *by JMI, convert BASIC to C*	495	399
BASIC-C *BASIC's functions added to C*	175	139
Report Option *Softcraft Btrieve Report Gen*	145	128
Xtrieve *Softcraft Query Utility for Btrieve*	245	220
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Dan Bricklin's Demo Program *Prototyper*	75	69
LMK *from Lattice, "make" like UNIX*	195	149
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C Utility Library	185	119
Essential Graphics	250	183
Essential Comm Library *with Breakout Debugger*	185	125
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Btrieve *by Softcraft, no royalties*	250	185
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RM/FORTRAN *by Ryan McFarland*	595	499
FORTRAN Libraries... *by Alpha Computer*	70	45
Microsoft FORTRAN *Links w/Microsoft C*	450	281
Microsoft FORTRAN *for XENIX*	695	546
Scientific Subroutine Package *by Alpha*	295	239
GRAPHICS		
Essential Graphics *Essential, no royalties*	250	210
GSS Graphics Development Toolkit	495	375
GSS Kernel System *by Graphic Software*	495	375
GSS Metafile Interpreter	295	235
Halo *by Media Cybernetics with Dr. Halo II*	300	219
	440	299
Halo for Microsoft *includes all fonts*	595	434
MICRO FOCUS PRODUCTS		
Micro Focus Level II COBOL *w/Animator*	495	395
Level II COBOL	349	279
Level II Animator	195	155
Micro Focus Personal COBOL	149	99
Forms-2	295	235
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MODULA-2 Apprentice Pkg *by LOGITECH*	99	79
MODULA-2 Magic Pkg *by LOGITECH*	99	79
MODULA-2 ROM Pkg & Cross RT Debugger	299	239
MODULA-2 Window Pkg *by LOGITECH*	49	39
MODULA-2 Wizard's Pkg *by LOGITECH*	199	159
OTHER LANGUAGES & UTILITIES		
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Tree Diagrammer *source code diagrammer*	55	45
Help/Control *by MDS 123 style Help*	125	109
Microsoft MuMath *includes MuSimp*	300	199
Microsoft Pascal Compiler *Links w/M'soft C*	300	199
Microsoft Pascal Compiler *for XENIX*	695	546
Turbo Power Tools+ *by Blaise*	100	67
Advantage C++ *by Lifeboat Assoc*	495	435
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PforCe++ *Function Library for C++*	395	235
Plink86 Plus *Utilizes memory for overlays*	495	325
Pmaker *like UNIX "make"*	125	85
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Pre-C *UNIX "lint"-alike*	295	174
PTel *Binary File Communicator*	195	115
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PVCS Personal	149	109
PVCS Network	Call	Call
PolyMake *Complete Make Utility*	149	109
PolyLibrarian *Library Manager*	99	73
PolyLibrarian II *Library Manager*	149	109
PolyShell *UNIX-like Command Shell*	149	109
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PolyXREF *One language only*	129	99
PolyBoost *The Software Accelerator*	80	64
PolyDesk III *3rd Generation Desktop Org*	99	73
PolyDesk III *Add On Tools*	Call	Call
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RM/FORTRAN *UNIX or XENIX*	750	599
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RM/COBOL 85 *ANSI 85 COBOL*	1250	995
RM/COBOL 85 RUN TIME	300	249
RM/SCREEN *for COBOL 85*	395	335
RM/NET+5 *COBOL & COBOL 85 Network*	300	248
SCREEN DESIGN		
Curses *by Lattice, UNIX screen designer with Source*	125	99
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Greenleaf Data Windows *New*	225	186
with source	395	297
Panel Plus *by Round Hill, no royalties New*	495	395
View Manager for C *by Blaise*	275	164
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VC Screen *by Creative Programming*	100	81
Windows for C *Vermont Creative Software*	245	219
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ZView *Data Management Consultants*	245	175
TEXT EDITORS		
Brief *from Solution Systems*	195	Call
Condor Editor *by Condor*	130	119
Edix *by Emerging Tech Multi-screen*	195	159
Epsilon *by Lugaru Software, like EMACS*	195	149
FireTime *by Spruce Technology, C syntax*	295	229
Kedit *by Mansfield, similar to Xedit*	125	99
LSE, the Lattice Screen Editor *Multi Wind*	125	100
Vedit *by Compuview*	150	99
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C Utility Library	$185	$119
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View Manager	$275	$164
Turbo Asynch Plus	$100	$ 67
Turbo Power Tools +	$100	$ 67

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GSS™ has reconfigured two components of its comprehensive graphics tools to conform with the ANSI Computer Graphics Interface (CGI) standard.

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GSS Kernel™ conforms to level 2b of ANSI's Graphical Kernel System (GKS) and contains all its needed drivers and language bindings. Kernel has macro level tools to draw and color an object, store the sequential instructions, and recreate the object on its own, as well as segment it, transform it, etc. So powerful, a single command may represent several score lower level statements.

Plotting has the equivalent GKS tools for graph and chart generation and their captioning: hand it apples and oranges, say "pie", and it bakes the numbers into a digestible display for screen or plotters.

Kernel and Plotting have tools to convert images they create to ANSI Computer Graphics Metafiles (CGMs), a tokenized standard for storing every form of graphic image as data. The Metafile Interpreter reads the contents of a CGM and interprets it with full CGI capability for recreation on various devices.

Quality software? IBM thinks so. They sell the GSS-series under their own label.

Ask for	List	PC Brand
GS010 CGI Dvlpmt Toolkit	$495	$375
GS020 Kernel System	$495	$375
GS025 Kernel for IBM RT	$795	$645
GS030 Plotting System	$495	$375
GS040 Metafile Interpreter	$295	$235

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Btrieve has mainframe specifications! Its balanced-tree indexing scheme finds any key in a million in four or less accesses. Files may have up to 24 indexes, fixed record length to 4090 characters, indexes up to 255 characters; files of 4 billion bytes. Can even extend a file across two drives—even two hard disks!

Version 4.x speeds DOS interaction for large multiply-keyed files, enables variable length records of virtually any length, verifies accuracy (optionally) with read after write, useful in gritty environments, offers password and data encryption.

There's also Xtrieve, for Btrieve file inquiry and data manipulation, and Rtrieve for report writing. All three in versions for any network that supports the MS-DOS 3.1 file sharing function.

Ask for	List	PC Brand
S0650	$250	$195
S0652 Network Version	$595	$465

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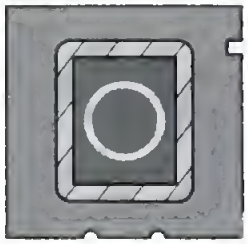

PC ADVISOR

Help in choosing a keyboard for a PC clone, in running Lotus's 1-2-3 from subdirectories, in graphing mathematical functions, and in sharing disks with the IBM Personal System/2.

REPLACEMENT KEYBOARD

I'm looking for a new keyboard for my generic PC clone. Just how interchangeable are keyboards across PC clones? Also, do you know of any keyboard with the IBM feel but without the mechanical click?

Scott Wood
River Edge, New Jersey

A replacement keyboard "just like IBM's" is one of our readers' most common requests. After poking and prodding many a keyboard, we've found that the Honeywell 84RX ($129, Honeywell Keyboard Division, El Paso, Tex.; (915) 544-5511) most closely mimics IBM's keyboard feel. The 84RX follows the basic layout of IBM's Enhanced AT layout (function keys in two columns along the left).

Honeywell does away with the mechanical click by using a rubber dome as a key actuator rather than the metal spring IBM uses. But if the IBM click is music to your ears, you can change a jumper setting on the Honeywell's circuit board to generate a click electrically.

In general, the only way to know whether a keyboard will work on any given machine is to ask the keyboard manufacturer or try it yourself. Honeywell reports that the 84RX will work on IBM's PC, XT, and AT, Honeywell PCs, and the Leading Edge Model D, among others. If you buy the keyboard and it won't work with your clone, Honeywell will refund your money.

If this sounds a bit like trial and error, that's because it is. The keyboard connector itself is a standard, but IBM has never settled upon and published one standard for the electrical signals exchanged between the keyboard and computer. One final note: IBM's PS/2 line makes use of a smaller keyboard connector, so you may not see third-party replacement keyboards for these machines for some time.

1-2-3 SUBDIRECTORIES

We set up separate subdirectories under our *1-2-3* directory for different people in our company. We'd like to run *1-2-3* from these subdirectories using batch files. Even after adding a path statement, we get errors when we try to execute the "lotus" command. Is there a way to do this without copying program files to each subdirectory? We use Release 1A.

Cathy Brown
Michele Nicastro
Milton, Pennsylvania

There are several ways to run 1-2-3 from a subdirectory or to achieve the same result. First, you can rid yourself of the file-loading errors by replacing the "lotus" command in your batch files with "123," remembering to include your path statement before the "123" command. This approach also bypasses the Lotus system access screen; hence you won't occupy as much memory.

If you don't want to bypass the access screen, you should consider attacking the problem from a different angle. You can enter 1-2-3 from the 1-2-3 directory and then change directories, manually or via macro. If you go this route, I strongly recommend that you upgrade to Release 2.01, which allows more flexibility in the use of subdirectories.

You should, in fact, try to keep all your software as up-to-date as possible. At least in theory, software upgrades address the wants and needs of the users, and upgrades are usually available to registered owners for a reasonable fee.

When you issue the "/fr" command in Release 2.01, 1-2-3 lists not only the files in the current directory, but also the names of any subdirectories. To view the files in a subdirectory, you move the cursor bar to that name and press Enter. Release 2.01 also lets you call a worksheet from another directory by entering the complete filename, including path and disk designations.

■ After poking and prodding many a keyboard, we've found that the Honeywell 84RX most closely mimics IBM's keyboard feel.

MAKING WAVES

I have been searching for a software package that is capable of fitting curves, plotting sine and cosine waves, and shifting and manipulating curves. Fourier calcula-

■ PC ADVISOR

tions would also be a helpful feature.

D. R. Scherping
Rochester, Minnesota

You've got a wide range of products from which to choose. If you're looking for quick and dirty graphics with a lot of punch per dollar, try MathCAD *($249, MathSoft Inc., Cambridge, Mass.; (617) 577-1017).* MathCAD *is more of an all-around mathematician's tool than a graphics package, but you'll find that it has plenty of graphics power as well.* MathCAD *lets you enter, edit, and chain together equations using the same symbols that you would on paper. You define what relationships you want graphed, and* MathCAD *automatically redraws the graphs when a variable changes.*

At the other end of the spectrum, Asyst *(Macmillan Software Co., New York, N.Y.; (212) 702-3241) offers more-flexible graphics but requires a hefty investment of time and money. With the capabilities you need, the package costs $1,995. And because* Asyst *is actually a programming language (a dialect of FORTH), it requires more time than* MathCAD *to master. Once up and running, however,* Asyst*'s graphics features are hard to beat.*

SHARING IBM PS/2 DISKS

You incorrectly reported in the June 9th issue (Volume 6 Number 11) that IBM PS/2 Models 50, 60, and 80 can read from 720K-byte floppy disks but cannot write to them. Although it is true you can use the special high-density 1.44-megabyte disks with these machines, you can also read and write to 720K-byte disks.

Eugene C. Goldhammer
Denver, Colorado

Right you are. We goofed.

The 1.44-megabyte drives in the PS/2 Models 50, 60, and 80 were designed to use high-density 3½-inch floppy disks, but they can also read and write to industry-standard 720K-byte disks.

If you want to use disks already formatted for 720K, just pop them in and you're ready to go. The PS/2 will recognize the format and automatically adjust. If you're formatting new disks and need compatibility with a 720K-byte drive, you'll have to use two additional parameters with the FORMAT command. Type

```
FORMAT /N:9 /T:80
```

IBM advises against formatting high-density disks to 720K or industry-standard disks to 1.44 megabytes, though you won't get an error message if you try it.

ASK THE ADVISOR

Send your questions to the PC Advisor, *PC Magazine*, One Park Avenue, New York, NY 10016. Please specify the precise equipment you are using.

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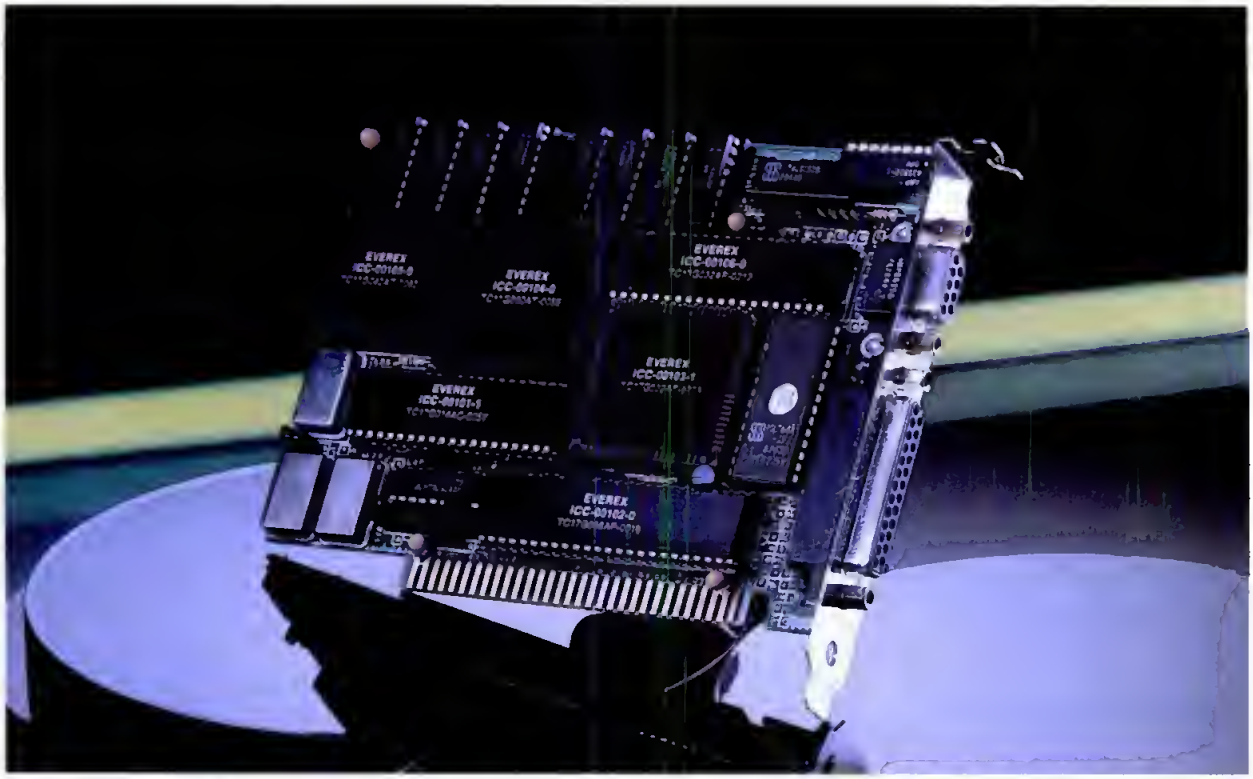

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PC MAGAZINE

FIRST LOOKS

SOMETHING BORROWED, SOMETHING NEW

386s from Kaypro and PC's Limited Press Speed Limits

PC HANDS ON

BY WINN L. ROSCH

Not many years ago, manufacturers were proud to build PCs out of off-the-shelf parts. Today, just putting a PC together is not enough. To earn the respect of the marketplace it's got to be a power user's box based on Intel's 80386 microprocessor, offering fast processing all the way through.

Two companies that have just entered the high-performance fray appear intent on winning exactly that respectability. Kaypro Corp., which built a reputation on innovative CP/M computers, is trying to move into the MS-DOS mainstream with its new Kaypro 386. PC's Limited, once little more than a mail-order vendor that bolted off-the-shelf components into computer cases to make budget-priced compatibles, now strives for leadership with its PC's Limited 386[16].

These two new 80386-based entries appear much alike. Both run their microprocessors at a full 16 MHz, both so strongly resemble the classic AT that you'd think they were designed with mirrors rather than by engineers, and both offer about double AT performance. Both include one internal full-height disk drive bay and three half-height bays, one of which is filled with an AT-style 1.2-megabyte floppy disk drive as standard equipment.

Most important, however, both machines mark major turnabouts from the first offspring of their corporate parents. For innovative Kaypro, the change is from pioneering to tagging along. The Kaypro 386 is an ordinary, essentially off-the-shelf machine. PC's Limited, on the other hand, innovates its way to making one of the fastest-running desktop computers available today.

Inside the shell of the Kay-

(continues on page 34)

At Last, Crosstalk Mark 4 Arrives: Worth Waiting for

PC HANDS ON

BY HOWARD MARKS

Crosstalk is a communications program with a long history. It began as a modem manager for CP/M machines and moved over to IBM PCs soon after such things came into existence; the most recent version until now—*Crosstalk XVI*, Version 3.6—shows that heritage. It's limited to chores that CP/M machines could handle: it can't display graphics, for instance.

Microstuf's announcement that it would make major improvements was warmly received back in April 1985, when shipment of *Crosstalk Mark 4* was deemed imminent; but as the months wore into years, no upgrade shipped, and Microstuf was acquired by the IRMA board manufacturer, DCA (Digital Communications

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Rolodex-like menus keep directory information, giving Crosstalk Mark 4 *a more accessible interface than its predecessor.*

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386s

(continued from page 33)

pro 386, the oscillator of Intel's prefabricated 80386 system board hums along, complete with all its virtues and limitations. Among the virtues are two 8-bit, four 16-bit, and two 32-bit expansion slots, plus one parallel and one serial port built into the system board.

One 16-bit slot is filled with a Western Digital WD1003 combined hard- and floppy-disk controller as standard equipment. For mass storage the system includes a 27-millisecond average access time Priam 40-megabyte hard disk that uses the standard ST506 interface. Kaypro includes Storage Dimensions' *SpeedStor* software to make the full capacity of the drive useful.

On the downside, the Kaypro runs its expansion bus at 8 MHz, inserts wait states in memory input and output, holds only 512K bytes of 32-bit dynamic RAM on its system board, and makes expanding DOS memory beyond that 512K difficult.

PC's Limited, on the other hand, attempts to extract the most performance possible from its chip and top clock speed. Instead of merely relying on a high-speed memory cache (as does Compaq), PC's Limited opted to make all of its memory high-speed static RAM, running without wait states. Instead of slowing down its expansion bus to 8 MHz (in order to achieve compatibility with stock expansion boards), the 386[16] gives you the option of running the bus at 12 MHz.

Two 8-bit, five 16-bit, and one proprietary 32-bit expansion slot are built into the system board. All system RAM is located on a standard equipment daughterboard that will hold up to 8 megabytes of 32-bit bus static SIMMs (single in-line memory modules). The factory endowment includes 1 megabyte of RAM.

An adapter supplies one serial and one parallel port; either one or two 16-bit slots are used for disk drive adapters, depending on the type of hard disk installed.

Even the BIOS is divided among four ROM chips to achieve full 32-bit bus width (most 80386-based PCs still use a 16-bit BIOS) and top performance, with special selectable routines to speed the operation of EGA-style graphics adapters.

Among the hard disk options is a 150-megabyte, 17-millisecond average access time Control Data disk that uses a double-speed (10-MHz) ESDI interface.

Although the standard PC Labs NOP benchmark test shows no difference between the performance of the two architectures, in most other benchmark tests the PC's Limited machine pulls far ahead of the Kaypro (and even the Compaq), at times crunching numbers 50 to 70 percent faster.

However, either of these systems makes any ordinary AT look lame.

Choose the Kaypro for the security and measure of compatibility earned by the Intel standard. The ubiquity of the Intel innards makes the Kaypro's 32-bit expansion conform to one of the more-popular buses being used in PCs.

The PC's Limited 386[16]

WIN Labs Redefines Value in a 386 PC

If you've been pricing the new 386 PCs, upgrading your computer system may be starting to seem like an expensive fantasy. The new WIN Labs 386 PC can change that. Unlike many 80386 machines, the WIN is not built around the Intel motherboard or the Chips and Technologies CHIPSet but uses a custom TTL design. The most unique part of the design is the base memory configuration.

Although sold with 1 megabyte of RAM standard, the RAM sockets are designed to accept four parity-checked rows of either 256K-byte or 1-megabyte chips. This allows memory to be upgraded by merely changing the chips and moving a jumper. Also included on the motherboard is 64K bytes of 40-nanosecond static-column RAM arranged in a 32-bit-wide cache.

Perhaps the best feature of the machine is the built-in diagnostics and setup programs. The well-designed programs are stored in the ROM BIOS and completely eliminate fumbling with floppy disks.

The remaining features are standard: an 80386 CPU running at 16 MHz (switchable to 8 MHz); a socket for an 8-MHz 80287; eight slots (six 16-bit, two 8-bit); and a 200-watt power supply. A hardware reset button is also included.

If you're looking for a solid 80386-based computer and if price and performance are two of your considerations, the WIN Labs 386 PC is the solution you've been waiting for.

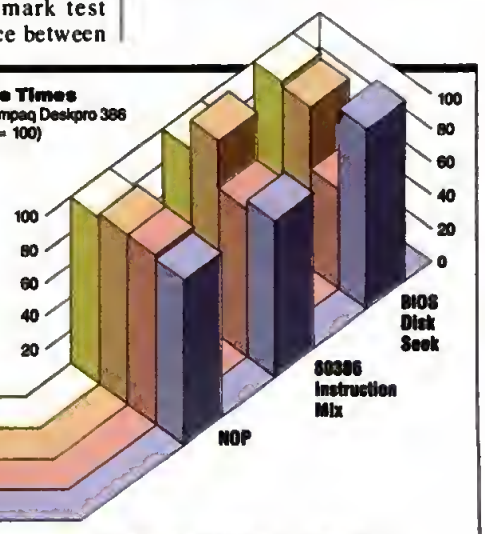
—Robert L. Hummel

Benchmark Tests: Compaq Deskpro 386 vs. PC's Limited 386[16], Kaypro 386, and WIN Labs 386

Extensive use of static RAM rather than dynamic gave the PC's Limited the clear edge in the instruction mix test. But a high-performance Control Data disk drive is what gives it its greatest speed advantage.

Performance Times
(Times given in seconds except where noted)

	NOP	80386 Instruction Mix	BIOS Disk Seek (milliseconds)
Compaq Deskpro 386	2.1	4.0	27.5
Kaypro 386	2.2	4.7	26.6
PC's Limited 386[16]	2.2	3.6	16.5
WIN Labs 386	2.1	3.8	29.9



The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instruction in a big 128K loop.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

WIN Labs 386
WIN Labs Ltd.
2701 Dorr Ave.
Fairfax, VA 22031
(703) 641-9077
List Price: $1,995 with t 2-Mbyte floppy disk drive; $3,685 with 1.2-Mbyte floppy disk drive, 720K-byte 3½-inch floppy disk drive, 40-Mbyte hard disk, EGA adapter and monitor.
In Short: Well-made 386-based PC that will be difficult to outgrow. Very expandable, thoughtful extra features, and a super competitive price.

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should top the list of anyone wanting today's utmost in performance and power. PC

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Kaypro 386
Kaypro Corp.
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Solano Beach, CA 92075
(800) 452-9776
List Price: $4,495 with floppy disk drive; $5,795 with floppy disk drive and 40-Mbyte hard disk; $8,095 with floppy disk drive and 130-Mbyte hard disk.
In Short: 386 PC built around Intel's motherboard and other standard off-the-shelf components.

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PC's Limited 386[16]
PC's Limited
The Dell Computer Corp.
1611 Headway Circle, Bldg. 3
Austin, TX 78754
(800) 426-5150
List Price: $4,499 with 1.2-Mbyte floppy disk drive, 40-Mbyte hard disk, Hercules-compatible graphics adapter, and monochrome monitor; $5,399 with 1.2-Mbyte floppy disk drive, 70-Mbyte hard disk, EGA adapter, and monitor.
In Short: Innovative and very-high-performing 386 PC, employing static RAM for some of the fastest processing available.

CIRCLE 441 ON READER SERVICE CARD

Crosstalk Mark 4

(continued from page 33)

Associates). Anticipation from *Crasstalk* fans grew into skepticism that anything significant would ever arrive.

Well, the long overdue ship has finally come in.

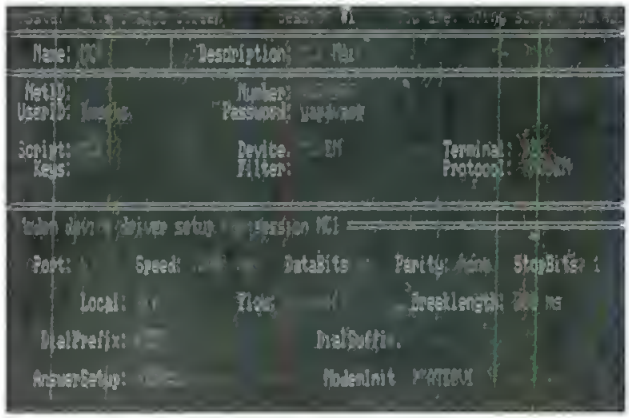
Crasstalk Mark 4 from DCA is a totally new product that truly takes advantage of the PC architecture. *Crosstalk Mark 4* achieves the often attempted but rarely attained goal of being an upgrade that is both more powerful and easier to use than its predecessor.

Crasstalk Mark 4's most important features are its programming language (CASL), its ability to support up to 15 simultaneous sessions, and its modular architecture. While other communications packages give you a script language with 20 or 30 commands that allow you to write a script to log on to a single electronic mail service, CASL has over 300 commands and functions, including window management, While-Wend flow control, and file-handling commands.

For example, with CASL you could write a script that, running unattended, used an IRMA board to log on to IBM's Profs, transferred mail to MCI Mail, saved each of your incoming messages on the host, and then forwarded those same messages via MCI Mail, so you could pick them up with your laptop from Bimini. The programmers at DCA have even written arcade games in CASL, although DCA does not distribute them with the program.

Unlike *Crosstalk XVI* or other communications packages that are made of one large piece of code, *Crosstalk Mark 4* is built from several modules. *Mark 4* uses separate modules for the device, terminal emulation, and file transfer protocol. When DCA decides to support additional devices, such as LAN gateways, all it has to do is make a new driver.

Since drivers are supplied for DCA's IRMA and Smart Alec boards, *Mark 4* may be the only communications program you need to talk to IBM mainframes, System/36s or System/38s, and the usual async hosts.



Crosstalk Mark 4's device module setup box, in the lower portion of the screen, shows current settings and allows you to change them.

Mark 4 emulates any of a dozen asynchronous terminals, including standards from Data General, Hazeltine, Televideo, and ADDS, as well as DEC VT-52, VT-102, and VT-220. *Mark 4* also supports most of the popular file transfer protocols, including Xmodem, Ymodem, CompuServe-B, Kermit, and the proprietary protocol used in *Crosstalk XVI*.

Mark 4 is also much easier to use than good ol' *Crasstalk XVI*. Instead of the status screen that had enough information to make even the most rabid propeller-head's beanie spin, *Mark 4* displays a simple menu when called up. *Mark 4* has a Rolodex-type phone book for the systems you call regularly. It also has a Learn script that allows you to create scripts just by doing what you want the script to do.

Dedicated *Crasstalk* users, fear not. Esoteric quotations still pop up when the program loads; even here, *Mark 4* improves by adding an updated selection.

In short, *Mark 4* is the most flexible communications package I've ever used. The powerful script language, combined with its ability to run multiple sessions and use DCA's emulation hardware, make *Crosstalk Mark 4* the new standard in communications software. PC

Crosstalk Mark 4's most important features are its programming language (CASL), its ability to support up to 15 simultaneous sessions, and its modular architecture.

PC MAGAZINE FACT FILE

Crosstalk Mark 4
Crosstalk Communications
Digital Communications Associates Inc.
1000 Holcomb Woods Pkwy.
Roswell, GA 30076
List Price: $245; upgrade, $50 plus $10 handling.
Requires: 256K RAM, hard disk recommended, DOS 2 1 or later.
In Short: A very flexible and powerful communications package that supports both asynchronous connections and IRMA boards, lending itself to use as a corporate standard. Not copy protected.

CIRCLE 440 ON READER SERVICE CARD

Write-in: Powerful 1-2-3 Word Processor Links Graphics, Text

PC HANDS ON

BY CHRISTOPHER BARR

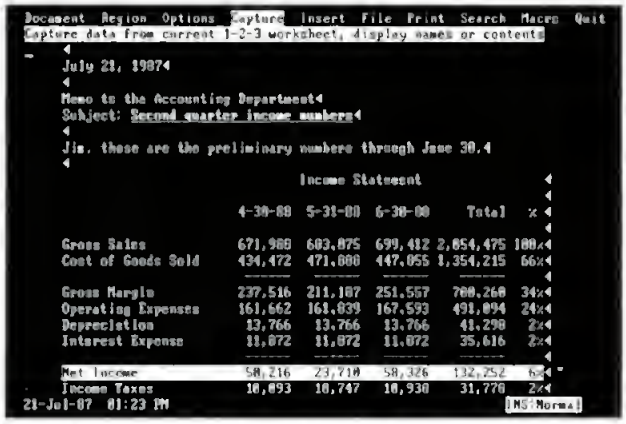
Lotus officially cut the ribbon for a gold mine of applications when it provided a tool kit to help programmers write add-ins for *1-2-3*. With the tool kit, developers can write programs that attach directly to *1-2-3* code (Release 2.x). *4-Word*, from Turner Hall Publishing, and *InWord*, from Funk Software (both reviewed in *PC Magazine*, Volume 6 Number 13), were the first to offer text editing for *1-2-3*, but both come up short next to *Write-in*.

Blossom Software Corp.'s *Write-in* is the most comprehensive add-in word processor for *1-2-3* so far, and it's the first of the bunch that lets you incorporate text with *1-2-3* graphics. That shouldn't come as too much of a surprise because Eric Schultz, *Write-in*'s creator and cofounder of Blossom Software, was a principal design engineer for *1-2-3*, Release 2.0, and a contributor to the design of the add-in environment.

What will surprise you is *Write-in*'s wealth of features and how easy the program is to use.

Write-in has multiple-line headers and footers; on-screen text justification to the left, right, even, or center; and 14 different character formats, including boldface, underline, italic, superscript, subscript, and strikethrough. Cursor movement is fast. Case-sensitive search-and-replace operations are possible with or without verify and the use of wildcards.

menu-driven command structure. *Write-in* uses nested menus à la *1-2-3*, but with a few twists; for example, speed keys that bypass the menus are available. *Write-in* has its own macro language, but goes *1-2-3* one



A Write-in document can maintain a hot link to an active spreadsheet, via the slash-command-operated menu.

Block-editing tools are on hand for use with large areas, but "speed delete" options let you zip through a document. Deleted text is stored in a clipboard and can be recalled at any time. *Write-in* automatically reformats the paragraph after the text has been deleted, inserted, or moved. Style sheets store paragraph formats that can be used on the fly. And macros are built in.

1-2-3 users will be very comfortable with *Write-in*'s

Write-in's macros, which are linked to Alt and Ctrl keys, have an auto-learning mode.

better: it has a learn facility that records your keystrokes. You can write 49 macros, each containing up to 80 keystrokes, and *Write-in* stores macros for repeated use.

All of *Write-in*'s printer and display support is managed by *1-2-3*, and changed through *1-2-3*'s installation procedure. On-screen you get up to 80 columns and a full 22 lines for text editing. *Write-in* has a preview feature that lets you display your document to screen before you print it. *Write-in* uses the text printer to print normal documents, and the *1-2-3* Printgraph utility in graphics mode, to print a document that combines text and graphics.

Write-in is powerful enough to use as a standalone word processor, but the real fun comes when you're working with an active spreadsheet. With *Write-in* you can link to, capture from, merge with, or print to a worksheet. The link feature puts a dynamic range from the active worksheet into the current document. The range can't be edited from the document side, but if you change a number or cell on the worksheet side, the document is updated.

Or you can do a straight copy from the worksheet into the document, and any changes made to the worksheet after the capture won't be updated in the document, although you can edit the document directly. The same holds true in reverse: you can place *Write-in* text into a worksheet, but it's not an interactive link, simply a straight copy function.

4-Word and *InWord* can do similar copy functions, but *Write-in* can place *1-2-3* graphs into a document—something possible until now only with fancy graphics presentation programs like *Inset* or *Show Partner*. *Write-in* lets you insert graphs that have been saved as .PIC files into reports; you can place either a single graph on a page or two next to each other.

As a bonus, *Write-in* creates an automatic backup of documents—a handy feature to have in a program—which might otherwise be too easily forgotten when you leave the spreadsheet that holds the bulk of your work, or execute a /System command.

1-2-3 devotees looking for bare-bones text editing may be happier with *4-Word*'s simple structure. But spreadsheet mavens with a taste for a powerful word processor will find everything they need in *Write-in*.

PC MAGAZINE FACT FILE

Write-in
Blossom Software Corp.
One Kendall Sq., #2200
Cambridge, MA 02142
(617) 577-8879
List Price: $99.95
Requires: 384K RAM; Lotus's *1-2-3*, Release 2.0 or later; DOS 2.0 or later.
In Short: *Write-in* is the most powerful of the *1-2-3* add-ins so far: a full-featured word processor that uses *1-2-3*–style commands and links graphics with text. Not copy protected.

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$299 WordCruncher: The Best Document Analysis Tool Around

PC HANDS ON

BY EDWARD MENDELSON

WordCruncher indexes text files ranging in size from the minuscule to the humongous and retrieves data in the twinkling of a cursor. It's a slick, swift program that comes with a bagful of tricks, an overelaborate interface, and an unfortunate name.

Unlike *ZyIndex* (First Looks, page 48, *PC Magazine*, Volume 6 Number 11) or the textbase in the *Nota Bene* word processor (First Looks, page 43, *PC Magazine*, Volume 6 Number 13), *WordCruncher* indexes individual files (up to about 3 megabytes each) rather than groups of files. But you can access an unlimited number of separate indexes from a menu or link up to 50 indexes into one monster index.

The program works best with files that don't change often, like literary texts, research archives, or files of scientific data. The publisher offers a nine-disk preindexed set of American historical documents called *The Constitution Papers*, and the firm hopes to issue sets of American and English literary works soon.

WordCruncher indexes your own files with impressive speed and creates a word-frequency list. You can tell it to insert numbered reference codes for each sentence or to paragraph automatically. It can read foreign characters and alphabetize in the proper sequence for different languages. It can compile and print a concordance of keywords in context. It performs sophisticated analyses of its indexes, and it can report whether certain words occur more often in one part of a document than in others.

WordCruncher *lets you search for single words or combinations in the same paragraph or a specified range. The response is nearly instantaneous*

Once text files have been properly digested, the latest version of *WordCruncher* proves to be the best tool there is for document analysis on a PC.

PC MAGAZINE FACT FILE

***WordCruncher*, Version 4.1**
Electronic Text Corp.
5600 N. University Ave.
Provo, UT 84604
(801) 226-0616
List Price: $299; *The Constitution Papers* text files, $79.
Requires: 512K RAM, hard disk recommended, DOS 2.1 or later (3.2 recommended).
In Short: Generates fast index and concordance from large text files. Not copy protected.

CIRCLE 428 ON READER SERVICE CARD

$50 Qmodem SST Adds More Script Language Muscle, Terminal Emulation

PC HANDS ON

BY JACK P. SPERLING

After trying several modem programs, every telecommunicator develops loves and hates. The Forbin Project's *Qmodem SST*, which blends ease of use with looks, power, and flexibility, is one for the "love" category. The latest version adds four terminal emulation modes and 22 commands for its powerful script language.

Qmodem's structure is similar to that of fellow shareware modem programs *PC-Talk III* and *ProComm*: mnemonic Alt-key sequences invoke major functions, Alt-D calls the dialing directory, and Alt-H hangs up. Its dialing directory beats both programs with up to 200 entries. Each entry has specific protocols, a linked script file that runs when a connection is made, and 35 characters of space to describe.

Internally, *Qmodem SST*'s protocols include ASCII, Ymodem, and three variations of Xmodem. But, cleverly, it lets you define external transfer protocol programs that can be run almost transparently. This feature gives it incredible expansion capabilities, since you won't have to wait for a new version of *Qmodem* each time a protocol is enhanced.

Menu windows that either pop up or explode into place make *Qmodem SST* fun and attractive. Color and placement of windows can be defined with the installation program, and various EGA modes—one providing an 80 by 57 screen—are supported. So is ANSI music.

Unlike previous versions, *Qmodem SST* has four terminal emulation modes: TTY, ANSI, VT100, and TVI925. The number of scroll-back lines is limited only by available memory, and you can clear or copy the buffer to a disk file. You can define 40 keyboard macros for calling script files, typing passwords, and so on.

Qmodem SST's script language is powerful, flexible, and at least as good as *ProComm*'s highly acclaimed language. It features commands to save and restore screens, draw windows, get user input, dial numbers, change protocols, and just about anything else you could hope for in a script language.

Although 19 files are needed to run it, QMODEM.COM is 41K bytes small. It seems like a bargain at $50, and because it's shareware, you can try it out before buying it.

PC MAGAZINE FACT FILE

Qmodem SST
The Forbin Project
4945 Colfax Ave. South
Minneapolis, MN 55409
(612) 824-1451
List Price: $50 with a printed manual; $40 with documentation on a disk; $30 for registration when downloaded from public bulletin boards; $10 for evaluation disks.
Requires: 256K RAM, Hayes-standard modem, DOS 2.1 or later.
In Short: A powerful, fast, and inexpensive communications program. Not copy protected.

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Create a business plan. Manage your time. Organize your thoughts into memos or letters. Even generate an itinerary or travel report. WordPerfect Executive lets you do it all on your desktop PC, or take it with you for your laptop.

Get the productivity software tailored for top management: WordPerfect Executive. For more information, call or write WordPerfect Corp., 288 West Center St., Orem, Utah 84057, (801) 225-5000.

WordPerfect
CORPORATION

CIRCLE 513 ON READER SERVICE CARD

ANNOUNCING ORACLE's NEW DIS

THE FIRST PRODUCT TO BREAK

WHY WAIT FOR OS/2? RUN LARGE APPLICATI

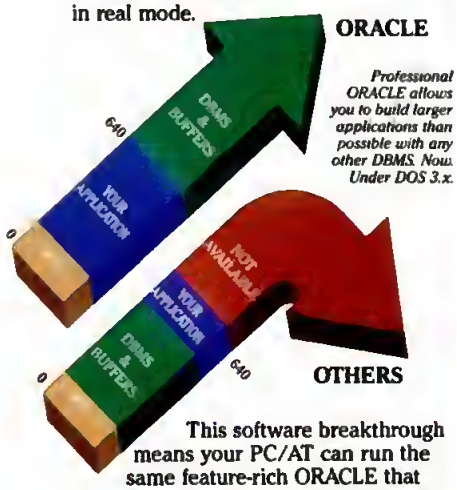
All PC DBMSs have three serious limitations. First, very little room is left for your application after deducting the size of DOS and the DBMS from the available 640K. Second, they don't provide easy, transparent access to minicomputer and mainframe data. Finally, multi-user applications are impractical because of long delays caused by LAN data lock-out. Three serious limitations. Not any more.

In 1979, Oracle Corporation delivered the very first relational DBMS. Oracle also delivered the very first implementation of SQL. And now, we're delivering the first ever distributed DBMS for PCs: *Professional ORACLE,® Networkstation ORACLE® and LANserver ORACLE.®* Three DBMS products that bring mainframe applications, mainframe data, and mainframe power to the desktop. All of which incorporate ORACLE's breakthrough technology. And all deliverable today.

EXPLOITS 286/386 PROTECTED MODE. NOW.

Professional ORACLE is the very first DBMS to exploit the advanced technology of PCs like the Compaq 386, IBM's PC/AT, and the new Personal System/2.

The ORACLE kernel—the relational DBMS engine—executes in protected mode. Above the 640K line in extended memory. At the same time, your ORACLE applications, tools, and DOS 3.x execute below the 640K line in real mode.



Professional ORACLE allows you to build larger applications than possible with any other DBMS. Now. Under DOS 3.x.

This software breakthrough means your PC/AT can run the same feature-rich ORACLE that mainframes run. Not a down-sized subset. Plus it leaves you plenty of memory to develop and execute major database applications. Without giving up your memory-resident utilities.

SEAMLESS CONNECTIVITY. NOW.

When other PC DBMSes claim "connectivity," they mean terminal emulation or file transfer, downloading and uploading static data snapshots.

With Networkstation ORACLE, an ordinary PC (XT as well as 286 or 386) becomes a true distributed application processor. You can dynamically access and update a remote database—either ORACLE or IBM's DB2†—as if it were stored on your PC.

What's more, ORACLE's SQL*Star distributed database architecture—the first ever on PCs—lets you query or update local PC and remote databases simultaneously. Even join them into a single view. Without knowing where your data is located. So you can distribute your data to where it's used the most. Control, secure, and back it up however you want. And still network it all together whenever you need to.

ORACLE Connectivity—PC to Database Server		
Speed Class	*Media*	*Raw Speed*
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Networkstation ORACLE works over Ethernet using DECnet protocols. Over 3270 coax using LU2 data streams. And over RS-232 and dial-up phone lines. With TCP/IP, APPC LU6.2 and other industry-standard protocols to come.

"Addresses all obstacles that have prevented full PC participation in a corporation's database-management activities." PC Week

ORACLE H

- Fully Utilizes 286/386 Technology
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- Database Server For PC LANs
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- Portability across VM, MVS, VAX/VMS, UNIX & others
- Develop Mainframe & Mini Applications On Desktop
- True Multi-User Concurrency
- Mainframe Data Integrity
- Distributed Processing
- Distributed Database
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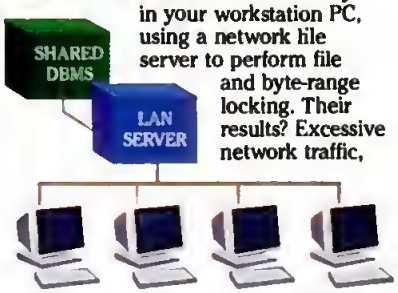
DATABASE SERVERS FOR LANs. NOW.

Using an Ethernet LAN, you can connect Networkstation ORACLE PCs to a variety of powerful ORACLE database servers. Such as the MicroVAX 2000. Soon, you'll be able to connect them to PC ATs, Personal System/2s or the new Compaq 386 running LANserver ORACLE.†

Other PC DBMSes execute entirely in your workstation PC, using a network file server to perform file and byte-range locking. Their results? Excessive network traffic,



frequent waits for busy records, and corrupted databases from aborted transaction streams.

ORACLE's database-server architecture ensures minimum network traffic, maximum concurrency, and data integrity for the most demanding multi-user applications. Just like a mainframe. And at one-fifth the cost of the least expensive proprietary database machine.

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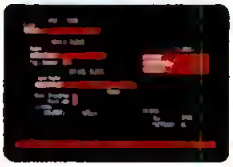
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO
NOW	NO	NO

SQL COMPATIBILITY. NOW.

ORACLE is compatible with both the ANSI-standard and IBM-standard SQL database language.

Which means you can develop applications in ORACLE on your PC and run them on the largest mainframe under ORACLE or IBM's DB2.



You can quickly paint, prototype and enhance sophisticated forms-based applications with minimum effort and maximum flexibility, using such optional facilities as SQL triggers and user exits.

UNRIVALED ORACLE PORTABILITY. NOW.

Moreover, your ORACLE PC applications also become automatically portable to over 30 minicomputer and mainframe families. Under VM, MVS, VAX/VMS, UNIX, and other operating systems.

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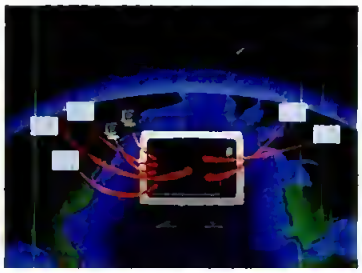

*ORACLE's SQL*Star distributed architecture allows you to manipulate your database—across multiple, dissimilar systems and operating environments—as if all the information were in a single database on your PC.*

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SQL*Calc. The 1-2-3-like spreadsheet that marries the world's most popular PC user interface with the world's most powerful PC DBMS.

Optional precompilers also let you access ORACLE from embedded SQL in COBOL or C-language programs.

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†DB2 connectivity and LANserver ORACLE for PCs available Q4 1987
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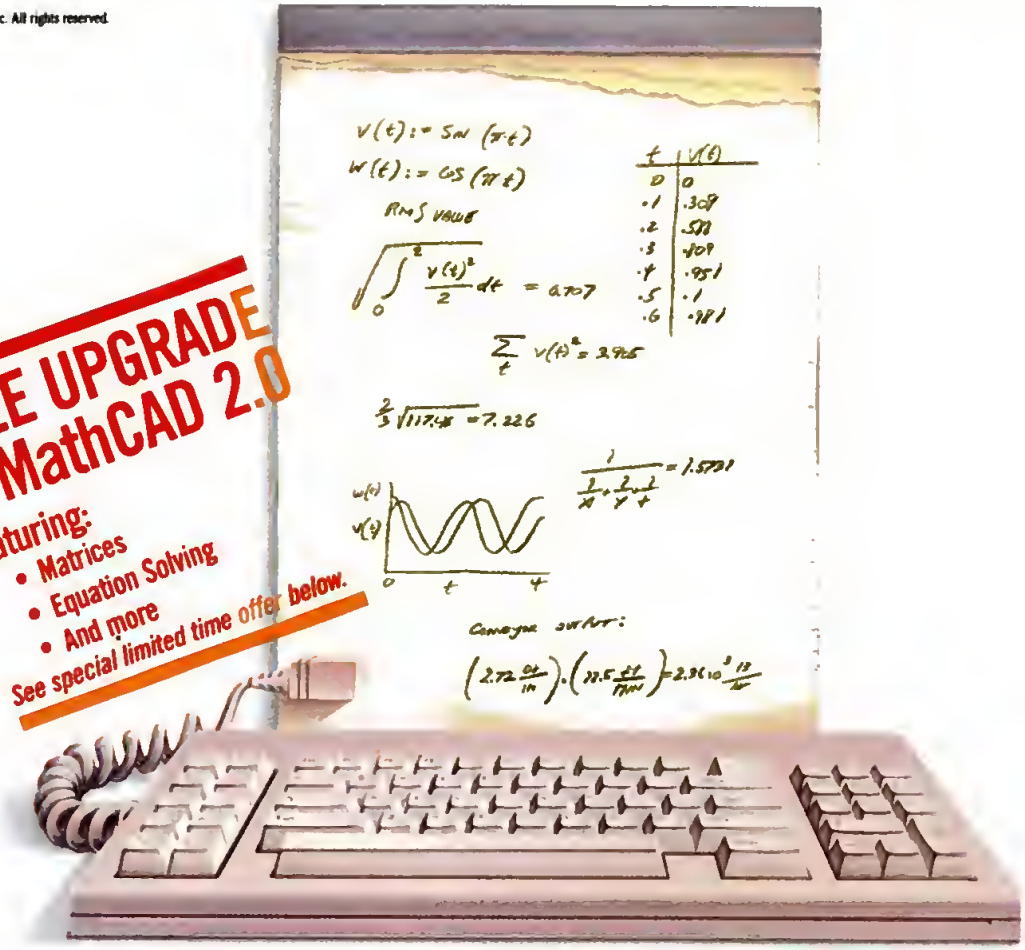

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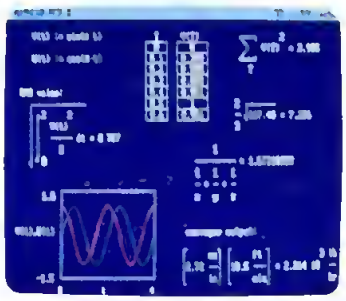

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CIRCLE 154 ON READER SERVICE CARD

Complete Answering Machine Takes Telephone Messages in the Background

PC HANDS ON

BY HOWARD MARKS

Every few years someone comes out with a new way to use your $3,000 computer as a telephone answering machine. The latest of these products is The Complete Answering Machine, from The Complete PC, which runs in the background so that you can still use your PC for other applications.The Complete Answering Machine (CAM) does have several voice mail features that you won't find on a normal answering machine. The CAM supports multiple "mailboxes" so that callers can leave private messages for different people on the same CAM. When the CAM answers the phone it can tell the caller to, say, dial 11 to leave a message for marketing or 12 to leave one for accounts payable.

(Watson, from Natural Microsystems of Natick, Massachusetts, is a similar product at a higher price. Watson users have the option of using the $498 Watson's VIS programming language, which allows them to build their own voice mail applications. Watson also includes a 1,200-bit-per-second modem.)

The CAM can handle up to 25 mailboxes; hence you can leave it connected to your switchboard and have it collect messages for your whole staff.

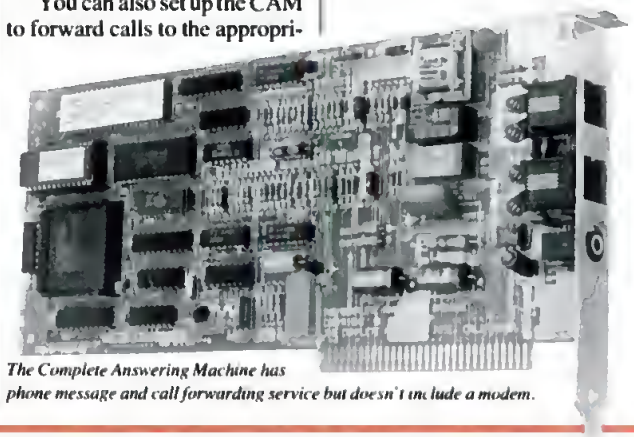
I especially liked its ability to forward messages. When you have messages in your mailbox, the CAM can call another phone number and play back the messages. The CAM can call a different number for each mailbox and can keep calling on a schedule you set up.

You can also set up the CAM to forward calls to the appropriate extension when the caller dials the code for each department. But the voice mail systems (available from Rolm, Northern Telecom, and other PBX vendors) can also take messages if an extension is off the hook or doesn't answer.

The sound quality of the digitalized messages is not as good as the best tape answering machines, but I think it's perfectly acceptable. I didn't have any trouble identifying voices.

The CAM takes one interrupt and a block of I/O ports. The software takes over 90K (94,480) bytes of RAM when running in the background.

The digitalized messages take quite a bit of disk space: 3.3K bytes per second of message, or 193K bytes per minute. In fact, The Complete PC recommends 1.5 megabytes per mailbox, but the biggest drawback of The Complete Answering Machine is that you have to leave your PC turned on all the time. If you don't use the sophisticated voice mail features, all you have is $3,000 worth of high-tech hardware pretending to be a $200 answering machine. PC



The Complete Answering Machine has phone message and call forwarding service but doesn't include a modem.

PC MAGAZINE FACT FILE

The Complete Answering Machine
The Complete PC
521 Cottonwood Dr
Milpitas, CA 95035
(408) 434-0145
List Price: $349
Requires: 256K RAM, hard disk, DOS 2.1 or later.
In Short: An add-in card and memory-resident software that turns your PC into the world's most expensive answering machine

CIRCLE 422 ON READER SERVICE CARD

Debugger Can Set up to Ten Types of Breakpoints

PC HANDS ON

BY STEPHEN RANDY DAVIS

Periscope, "The Undercover Debugger," is another of those full-screen, symbolic assembler debuggers. Based loosely on DOS DEBUG, *Periscope* adds numerous capabilities, including symbolic debugging, multiple breakpoint types, and a windowed interface.

Periscope relies on the .MAP file output from the DOS LINKer to determine the location of user-defined symbols. Your compiler or assembler must be able to include such symbol information in its object output for *Periscope*'s symbolic features to be useful. When this information is present, *Periscope* can include source code with the machine code disassemblies, and it allows breakpoints to be set on source code statements as well as machine instructions.

Breakpoints are one of *Periscope*'s most powerful command features. The program defines some ten different types, ranging from standard "break on execute" through "break when memory range accessed" right on up to "break on user-defined condition." Although based on DEBUG, *Periscope*'s other one- and two-letter commands are difficult to remember due to their sheer number. Thankfully, on-line help is available, as is a QuickReference Card.

Periscope comes in three models. Model I has a PC half-card containing 56K bytes of protected RAM into which *Periscope* loads itself so it will be protected from errant user code, much like a turtle withdrawing into its shell. Included is a "break-out" switch to bring *Periscope* back to its senses when the user program has gotten lost. This version of *Periscope* is virtually uncrashable.

Model II includes a break-out switch but not the protected memory, for a slightly lower level of protection, and finally, Model II-x includes neither.

Periscope will use two monitors, if available, for dual-screen debugging. PC

PC MAGAZINE FACT FILE

***Periscope*, Version 3.0**
The Periscope Co.
14 Bonnie Ln.
Atlanta, GA 30328
(800) 722-7006
(404) 256-3860
List Price: Model I, $345; Model II, $175; Model II-x, $145.
In Short: Powerful debugger, available in software only or hardware/software combination. Not copy protected.

CIRCLE 425 ON READER SERVICE CARD

NEW ON THE MARKET

Graphics Card Displays Color Software on Any Standard Mono Screen

Paradise Systems has introduced a video display adapter that allows PCs, XTs, ATs, and compatibles to display color software on monochrome monitors, emulating the EGA palette in shades of gray, green, or amber. A short card, the $249 Paradise AutoSwitch monochrome EGA card displays EGA, CGA, MDA, and Hercules software. The card automatically switches between video modes and has a printer port.

The AutoSwitch card displays *Framework*, *WordStar*, and *WordPerfect* in 132-column mode. It comes with 256K bytes of video memory.

List Price: Paradise AutoSwitch monochrome EGA, $249.
Requires: Expansion slot, monochrome monitor. Paradise Systems Inc., 217 E. Grand Ave., South San Francisco, CA 94080; (415) 588-6000.

CIRCLE **433** ON READER SERVICE CARD

Fujitsu Six-Pen Plotter Has a Small Footprint And Competitive Price

Fujitsu Component Corp. of America has entered the plotter market with the Imagegraph, a $1,200, six-pen desktop pen plotter.

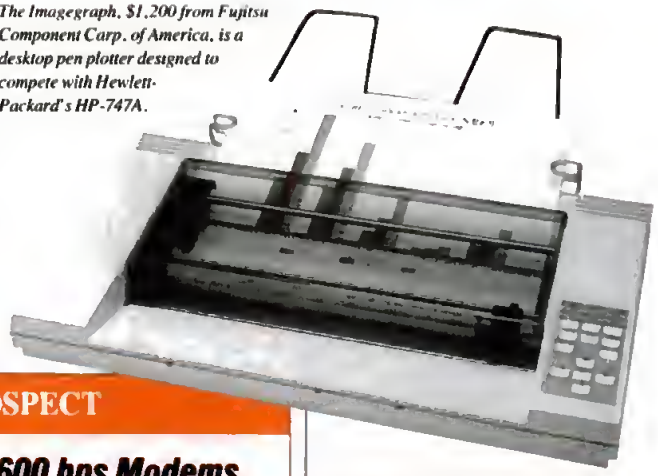
The Imagegraph is compatible with Hewlett-Packard's graphics language, Fujitsu says, and it emulates Hewlett-Packard's HP-747A plotter. Fujitsu claims that the new plotter takes up half the desk space that the HP-747A does, costs over 35 percent less, and comes with both serial and parallel interfaces. It also plots on a wider variety of media sizes, Fujitsu says, at a resolution equal to that provided by the HP plotter.

The Imagegraph plots on several types of media, including paper, coated paper, transparencies, and polyester drafting film. It accommodates media as small as a postcard and as large as B-size formats.

Maximum pen plotting speed is 10 inches per second, according to Fujitsu. A 6K-byte buffer is provided to enhance throughput.

List Price: Imagegraph, $1,200.
Fujitsu Component Corp. of America Inc., 3320 Scott Blvd., Santa Clara, CA 95054; (408) 562-1000.

CIRCLE **435** ON READER SERVICE CARD



The Imagegraph, $1,200 from Fujitsu Component Corp. of America, is a desktop pen plotter designed to compete with Hewlett-Packard's HP-747A.

HOT PROSPECT

Hayes Debuts Two 9600 bps Modems, V-Series Extensions to Command Set

Hayes Microcomputer Products has raised the bar two notches on high-speed asynchronous communications standards by introducing a 9,600-bit-per-second PC modem and an extension of the Hayes command set called the V-Series. The $1,299 V-Series Smartmodem 9600 (external) and the $1,199 V-Series Smartmodem 9600B (internal) take advantage of this new command superset.

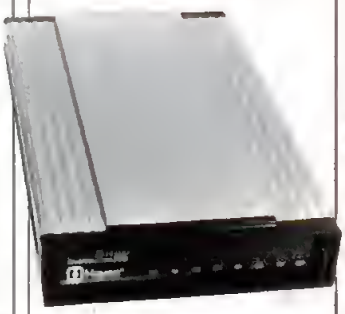
Hayes will introduce V-Series modems at 1,200 and 4,800 bps and will sell a separate $349 box to add V-Series error correction and data compression features to current Hayes modems. The V-Series implements the LAPB link level portion of the X.25 protocol and an asynchronous framing technique. This allows point-to-point error control, supports international standards, and clears a migration path to X.25 or other synchronous communications protocols.

At the time of connection, the modems analyze all of the options available for a modem link—including speed—and select the combination that maximizes data transmission efficiency, Hayes says.

The new Smartmodems are half-duplex modems. They implement V.32 Trellis code modulation and fast-turnaround "ping-pong" technology, according to Hayes, to give you the benefits of simulated full-duplex transmission at considerably lower prices.

List Price: V-Series Smartmodem 9600, $1,299; V-Series Smartmodem 9600B, $1,199.
Requires: V-Series Smartmodem 9600: serial port; V-Series Smartmodem 9600B: expansion slot. Hayes Microcomputer Products Inc., P.O. Box 105203, Atlanta, GA 30348; (404) 449-8791.

CIRCLE **430** ON READER SERVICE CARD



New 9,600 bps modems ($1,299 external, $1,199 internal) from Hayes offer sophisticated error correction and adaptive data compression.

Sigma Designs Offers VGA Compatibility for The Old-Bus Computers

Among the latest to announce a graphics card that's compatible with the new IBM VGA standard is **Sigma Designs**. The $579 SigmaVGA provides old-bus computers with the same graphics capabilities offered by the integrated VGA graphics adapters in IBM's PS/2 line.

The board supports 320- by 200-pixel resolution in 256 colors or 64 gray scales. It also provides 640- by 480-pixel resolution in 16 colors or gray scales for all point sizes of addressable text and graphics. The 720- by 400-pixel resolution in 16 colors or gray scales for high-resolution text is also supported.

The SigmaVGA is backward compatible with MDA, CGA, and EGA modes, and it directly interfaces with the PS/2 analog monitors and compatibles. Sigma says the card comes with 256K bytes of on-board memory and incorporates the same digital-to-analog converter used by IBM. It offers up to 256 simultaneous colors from a palette of 256,000.

List Price: SigmaVGA, $579.
Requires: PS/2 analog monitor or compatible, expansion slot. Sigma Designs Inc., 46501 Landing Pkwy., Fremont, CA 94538; (415) 770-0100.

CIRCLE **434** ON READER SERVICE CARD

by Jonathan Matzkin

NEC Introduces MultiSync Plus as the Successor to Original Multiscan Monitor

NEC's $1,399 MultiSync Plus offers compatibility with IBM's new graphics standards and a choice of three monochrome screen colors The MultiSync can display as many as 64 colors at a time when the monitor is used with a TTL signal

Since its introduction in 1985, the NEC MultiSync has become synonymous with multiscanning color monitors. Now **NEC Home Electronics (U.S.A.)** has introduced the $1,399 MultiSync Plus, which offers compatibility with IBM's old-bus computers, the new PS/2 line, and Apple Computer's Macintosh II.

The MultiSync Plus offers resolution of up to 960 by 720 pixels and automatically synchronized scan rates of 21.8 to 45 kHz horizontally and 50 to 80 Hz vertically. The new monitor's dot pitch is the same .31mm of the original MultiSync.

Up to 64 colors can be displayed at once on the MultiSync Plus's 14-inch display area when the monitor is used with a TTL signal. The monitor displays an unlimited number of colors when driven by an analog signal.

A three-way text-mode switch turns the MultiSync Plus into a monochrome monitor. You can select green, amber, or paper-white screen colors.

The MultiSync Plus is supplied with a standard 9-pin D-sub video connector, as well as a BNC connector. An adapter to use the monitor with TTL boards is optional.

List Price: NEC MultiSync Plus, $1,399 NEC Home Electronics (U.S.A) Inc., 1255 Michael Dr., Wood Dale, IL 60191; (312) 860-9500

CIRCLE **431** ON READER SERVICE CARD

80286-, 80386-based Compatibles Have CPUs Mounted on Plug-in Circuit Boards

IBM's PS/2 revolution may eventually rule the market, but the old bus technology is far from dead. Proof is found in new modular PC architectures introduced by **Wyse Technology** and **NCR Corp**.

Wyse has debuted 80286 and 80386 PCs that employ a "modular systems architecture" for increased flexibility and expandability. The PCs feature CPUs mounted on plug-in circuit boards to allow easy replacement or upgrading. The CPU cards mount in a passive back plane, and you can upgrade from an 80286 to an 80386 CPU by simply swapping circuit boards.

The WYSEpc 386 Model 3216 ($3,799 with one floppy disk drive, $4,999 with a 40-megabyte hard disk) has a 16-MHz 80386 processor. It has nine expansion slots and can accommodate up to 24 megabytes of RAM.

Among the 80286 CPU systems is the WYSEpc 286 Model 2112, which offers switch-selectable 12.5- and 8-MHz clock speeds in a small footprint case. It comes with 1 megabyte of RAM, seven AT-compatible expansion slots, and a 190-watt power supply. The system costs $2,299 with a single floppy disk drive and $3,499 with a 40-megabyte hard disk.

NCR's PC810 has an 80286-10 microprocessor that runs at 6 or 10 MHz and is mounted on a card along with the system's RAM. A second board contains the video adapter, disk drive controllers, extended memory, and serial and parallel ports. The basic configuration, with 640K bytes of RAM, single floppy disk drive, and no graphics adapter, costs $2,950.

The 80386-based PC916 features an enhanced version of the modular architecture found in the PC810. The processor and primary memory are mounted on separate cards, which occupy two slots in the system's eight-slot bus. The two cards are directly connected by a 32-bit "extender bus." The basic system, with an 80386-16 processor board, 2 megabytes of RAM on a separate board, a 1.2-megabyte floppy disk drive, a 30-megabyte hard disk, and EGA support, costs $6,353.

NCR's PC810 ($2,950) is an AT-compatible 80286 PC that employs a modular architecture to allow easy upgrades.

List Price: WYSEpc 386 Model 3216 with one floppy disk drive, $3,799; with 40-Mbyte hard disk, $4,999. WYSEpc 286 Model 2112 with one floppy disk drive, $2,299; with 40-Mbyte hard disk, $3,499. Wyse Technology, 3571 N. First St., San Jose, CA 95134; (408) 433-1000.

CIRCLE **438** ON READER SERVICE CARD

List Price: PC810 with 640K RAM, one floppy disk drive, $2,950; PC916 with 2 Mbytes RAM, 1.2-Mbyte floppy disk drive, 30-Mbyte hard disk, EGA support, $6,353. NCR Corp., Personal Computer Division, Dayton, OH 45479; contact local NCR sales office.

CIRCLE **432** ON READER SERVICE CARD

Complete Source Code Debugger Attaches Itself to Turbo Pascal

PC HANDS ON

BY STEPHEN RANDY DAVIS

Just when we thought we had found all of the source code debuggers for Turbo Pascal (see "Power Utilities for Turbo Pascal," *PC Magazine*, Volume 6 Number 12), enter *TURBOsmith*, Version 1.1e, from Visual Age, maker of the old standby assembler debugger, *CODEsmith*.

To start *TURBOsmith* you simply enter TSM rather than TURBO at the command line. *TURBOsmith* loads and bonds itself to the compiler, forming what appears to you as a single program. The solitary difference within the Turbo environment is a new command added to the menu list: T(race). This new command recompiles your program and then enters the debugger.

TURBOsmith is a highly windowed environment. Initially you are presented with a source code window above and a data window below. The source code window shows the Turbo program with the currently executing line highlighted—the data window displays all of the globally defined variables, including those defined by Turbo Pascal itself. From the code window, you can do all of the normal "debugger" sorts of things: single step, set break points, and so on. Somewhat unexpected is *TURBOsmith*'s "break on data" command, which allows you to execute your program until a particular location or register changes value—very useful when trying to figure out who's clobbering a memory location.

As the user code enters and exits procedures, *TURBOsmith* opens and closes new data windows, each one containing only the variables defined in that procedure. No matter where you are, however, you can always scroll back through previous data windows via a function key. Besides the code window and data windows, you can also call up hexadecimal dump and assembler code windows.

TURBOsmith gives the feeling of being a "professional" debugger. That doesn't mean it's better, exactly—just slightly more capable. For example, when it comes time to single-step through a section of INLINE code, *TURBOsmith* can open up a machine code window, which is synchronized in lockstep with the source code window. *TURBOsmith* even has a built-in assembler to allow you to make patches or create INLINE code, without Pascal variable references, on the spot.

TURBOsmith's window environment allows you to split the program and view data variables (below), while setting the break points.

Behind the window-based command debugger lies a command-oriented, assembler-based debugger that can be called up at any time. Although not usually necessary, this "behind the scenes" debugger stands ready for serious debugging. Keep the manual handy, however, as there is no built-in help to prod your memory.

PC MAGAZINE FACT FILE

***TURBOsmith*, Version 1.1e**
Visual Age
642 N. Larchmont Blvd.
Los Angeles, CA 90004
(800) 732-2345
(213) 534-4202
List Price: $69
Requires: 512K RAM, PC-DOS Turbo Pascal, Versions 3.01A and 3.02A; does not support the generic MS-DOS versions.
In Short: A full-featured source code debugger that attaches itself to Turbo Pascal. Not copy protected.

CIRCLE 421 ON READER SERVICE CARD

EXE2COM: A Free Replacement for IBM's Suddenly Expensive EXE2BIN

PC HANDS ON

BY EDWARD MENDELSON

DOS 3.3 giveth, and it also taketh away. If you try to create a .COM file using the assembler code printed in *PC Magazine* or anywhere else, you'll grind to a halt when you find that you no longer have EXE2BIN.EXE, the program that converts .EXE files to .COM files. IBM moved EXE2BIN and LINK to the disk that comes along with the $85 *Technical Reference* manual for DOS 3.3.

DEBUG is still on the DOS disk, although its documentation has moved over to the tech ref book.

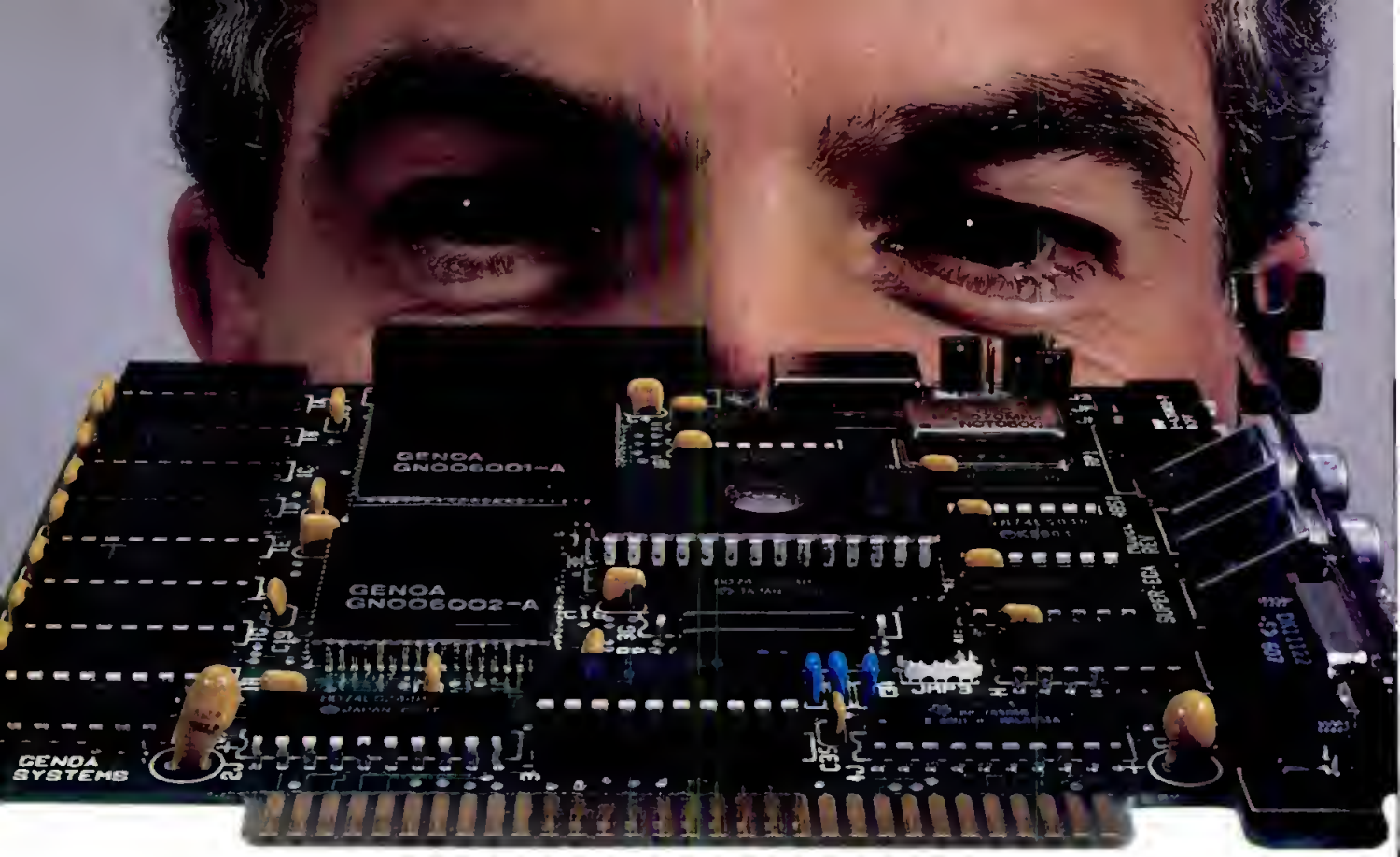
You won't miss LINK, because any assembler package has a replacement that works better. But even amateur programmers need EXE2BIN, and now there's a public-domain substitute from The Cove Software Group. Chris Dunford's EXE2COM.EXE does everything EXE2BIN.EXE did, uses a more sensible syntax, and throws in a much better set of error messages as a bonus. You can find it in CompuServe's IBMNET, on many BBSs, or on the PC Magazine Interactive Reader Service ((212) 696-0360, in the Productivity section).

It works with all DOS versions, and the phone call to download it will cost you about $83 less than the DOS *Technical Reference* manual.

PC MAGAZINE FACT FILE

EXE2COM.EXE
Christopher J. Dunford
The Cove Software Group
P.O. Box 1072
Columbia, MD 21044
(301) 992-9371
List Price: Free (Cove will send the program to anyone who mails in a formatted disk and stamped return mailer.)
Requires: DOS 2.0 or later.
In Short: A public-domain improvement on EXE2BIN. Not copy protected.

CIRCLE 420 ON READER SERVICE CARD



For Real EGA Compatibility, Come to Our Level.

Our Super EGA™ board is compatible all the way down to the chip register level —so compatibility is embedded in the hardware, not in the software like most EGA boards. And these chips are special: they're our own proprietary VLSI design.

- Requires no software emulation.
- 100% compatible with EGA, CGA, MDA, Hercules, TGA (640 x 400) and PGA (640 x 480).

Super Speed

- Genoa's chip set and Super BIOS™ make this one of the fastest graphics cards made.
- Operates with 4.77, 6, 8, 10, 12 or 16 MHz CPUs—with higher speeds on the way.

Super Resolution

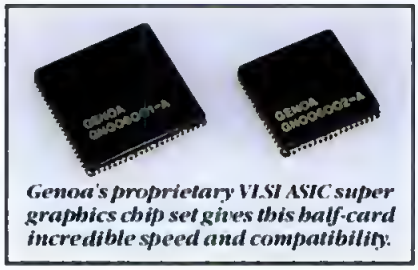
- In EGA mode: 132 x 44, 32, 29 and 25.
- Up to 1056 x 352 pixels.
- Supports highest resolution available today (PGA).
- Displays 3270 format (Models 2, 3, 4 and 5).

Super Reliability

- Low-power CMOS VLSI chip set assures long life.
- Our dealers will tell you: our boards are the most reliable on the market!

Super Driver

- Genoa's software driver for Lotus and Symphony spreadsheet applications makes the Super EGA board a clear winner. All 132 columns are displayed on the screen at once.



Genoa's proprietary VLSI ASIC super graphics chip set gives this half-card incredible speed and compatibility.

Super OEMs Wanted

In addition to the ready-to-use half card, Genoa offers the custom board designs and the advanced CMOS VLSI Super EGA chip set to OEMs. Call for details.

For more information on Genoa's Super EGA board, call us at 408-432-9090, or write: Genoa Systems Corporation, 73 E. Trimble Road, San Jose, CA 95131.

Genoa
SYSTEMS CORPORATION

We make PCs better.

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Lotus and Symphony are trademarks of Lotus Development Corporation
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CIRCLE 239 ON READER SERVICE CARD

Newcomer FastCAD Puts Speed, Precision in High-End Design

PC HANDS ON

BY DR. JOEL N. ORR

Most people, when spending more than $2,000 for a software program, prefer to stick with a company that has a longstanding reputation. Mike Riddle, one of the original authors of *AutoCAD*, may be able to change more than a few minds on that score. He's written a fast, flexible 2-D drafting program called *FastCAD* and has formed a new CAD software firm, Evolution Computing, around the product.

FastCAD lives up to its name: written in assembly language, it has blinding speed when run with a math coprocessor. On a Leading Edge XT clone with a Hercules graphics board and an 8087, the famous *AutoCAD* fire hose nozzle (a 35K-byte file) loaded in about 12 seconds (*FastCAD* can read and write .DXF files). A 2X zoom of the drawing took about 5 seconds; going from full size to half size took about the same amount of time.

Many other CAD programs achieve speedy responses by using integers for coordinates. This sacrifices precision and the ability to depict small objects in a large drawing. *FastCAD* uses full floating-point coordinates.

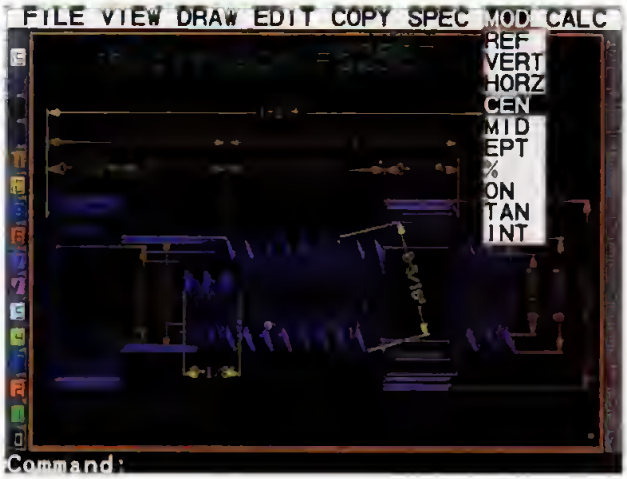
I found *FastCAD* to be very powerful. It accepts both graphic and text input to almost all of its commands, making it possible to enter coordinates and measurements precisely.

FastCAD has a full range of 2-D drafting commands, but it lacks cross-hatching. A "fill" command can color certain closed shapes but does not do the job of a hatching facility.

A full-featured user programming language, complete with conditional branching, looping, and user input prompting, is provided; in fact, this language is the text-driven underpinning of *FastCAD*. The language allows the creation of alternate menu files through the use of a text editor; menus can be automatically invoked when a particular drawing is loaded.

Drawing commands can be interrupted by various operations, such as zoom or endpoint. For instance, you can zoom in on one end of a long object, place the first point of a line, then zoom out, zoom in on the other end of the object, activate the endpoint snap command, and place the second point of the line.

For a newcomer to the CAD scene, *FastCAD* has a superb arsenal of features: it supports a wide range of input, display, and output devices and has an excellent manual. It will appeal to anyone seeking a high-end, accessible design program. PC



With an excellent range of features and an accessible structure, FastCAD *has few shortcomings: its lack of cross-hatching is one of them.*

PC MAGAZINE FACT FILE

FastCAD
Evolution Computing
437 S. 48th St.
Tempe, AZ 85281
(602) 967-8633
List Price: $2,295
Requires: 512K RAM; 8087 or 80287 math coprocessor; CGA, EGA, or Hercules graphics adapter; DOS 2.0 or later.
In Short: Fast, powerful design program with an accessible structure. Not copy protected.

CIRCLE 427 ON READER SERVICE CARD

A86: A $50 Macro Assembler

PC HANDS ON

BY STEPHEN RANDY DAVIS

The next time one of your friends offers you a copy of this great new assembler he just got, don't call the Pirate Police right away—ask first if it isn't a copy of *A86*. As shareware, *A86* can be distributed freely for trial, although registration is required for continued use.

A86 claims to assemble at more than 1,000 lines per minute, and although my tests did not duplicate that rate, I can verify that it is indeed very fast. *A86* can generate either an .OBJ file or a .COM file directly, thereby saving more time by avoiding the link step. Support is provided for 8087 floating-point and 80186, 80286, and NEC instructions. *A86* even assembles a few 8086 instructions that Intel doesn't admit exist!

Upper and lowercase identifiers can be differentiated for linking with C object files.

A86 is not completely Microsoft MASM compatible, which can be a nuisance when trying to assemble programs from other sources. Yet, *A86* is easier for the beginner, not requiring (but understanding) the ASSUMEs and SEGMENT definitions that MASM requires for even the simplest assembly program.

Interestingly, *A86* inserts its error messages directly into the source file. Although this feature can be disabled, it aids in the error correction process. *A86* automatically removes error messages left in the source file from previous assemblies.

The *A86* package is available as shareware or directly from its author, Eric Isaacson. Registered users receive an assembler source code library utility. Because the author provides technical support by himself, reaching him can be something of a chore, so avoid *A86* if you think you'll be needing to make frequent calls. PC

PC MAGAZINE FACT FILE

***A86*, Version 3.03**
Eric Isaacson Software
416 E. University St.
Bloomington, IN 47401
(812) 339-1811
List Price: $50; debugger, $80; demonstration disk, $10.
Requires: DOS 2.1 or later.
In Short: A very fast shareware macro assembler. Not copy protected.

CIRCLE 430 ON READER SERVICE CARD

For high speed, high performance data integration, look into Magic Mirror.™

Now you can move data instantly from one program to another — right from your PC screen.

Now you can transfer parts of a spreadsheet directly into your database — or move sections of a document straight into a spreadsheet — without retyping your data, and without a single mistake.

It's all done with Magic Mirror — the unique memory resident program that lets you quickly select any information directly off your PC screen and instantly feed it into any other program — in exactly the right format, with exactly the results you want.

Highlight only the information you want to feed to another program. Magic Mirror then transfers it instantly, accurately, and effortlessly.

With Magic Mirror, it's easy to do the impossible.

Let's say you're preparing a spreadsheet, and you want to include some budget information from a word processing document.

Simply use Magic Mirror to highlight those sections of the document with the information you want, and save them in memory.

Now call up your spreadsheet, hit a couple of keys, and watch as your budget is automatically entered into the right cells — in the proper format — as though you were typing the information yourself at a blinding speed.

With Magic Mirror it's easy. Without Magic Mirror, it's impossible.

It's the complete do-it-yourself data integration tool.

The secret behind Magic Mirror is its ability to automatically edit and reformat data while it's transferring. That's significant because the way one program displays information is usually not the way another program will accept it. No problem.

Select a few simple options, and Magic Mirror removes dollar signs, inserts carriage returns and other control characters, strips out spaces — whatever it takes to make once incompatible data look and act just like it was entered for the program you're sending it to.

Plus, it remembers everything it does — from the way it captures data, to the way it edits and reformats, to the way it transfers data. So it's simple to repeat Magic Mirror operations instantly. Or set up routines that others can use with ease.

Get tomorrow's software technology today.

Some day, far in the future, maybe all PC software will share data effortlessly from one application to another. But why wait, when you can do it yourself today at such a very low cost?

Ask for Magic Mirror at computer dealers everywhere. Or order direct from SoftLogic Solutions by calling 800-272-9900 (603-627-9900 in New Hampshire), or send the coupon below. If you find it does not meet our advertised claims within 30 days of purchase, we'll gladly arrange for a prompt refund.

Here's what Magic Mirror can do for you.

- Saves you time and money on communications by capturing and storing just the data you want while running on-line information services. No need to transfer complete files.
- Helps prepare reports quickly using data collected from any number of files and programs, so you get all the advantages of a pre-packaged integrated software system without its limitations.
- Gives you the most powerful integrated software system available when used along with SoftLogic Solutions Software Carousel™. A system that unifies all your favorite software.

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Magic Mirror $89.95*

Yes, send me Magic Mirror for just $89.95* (not copy protected).

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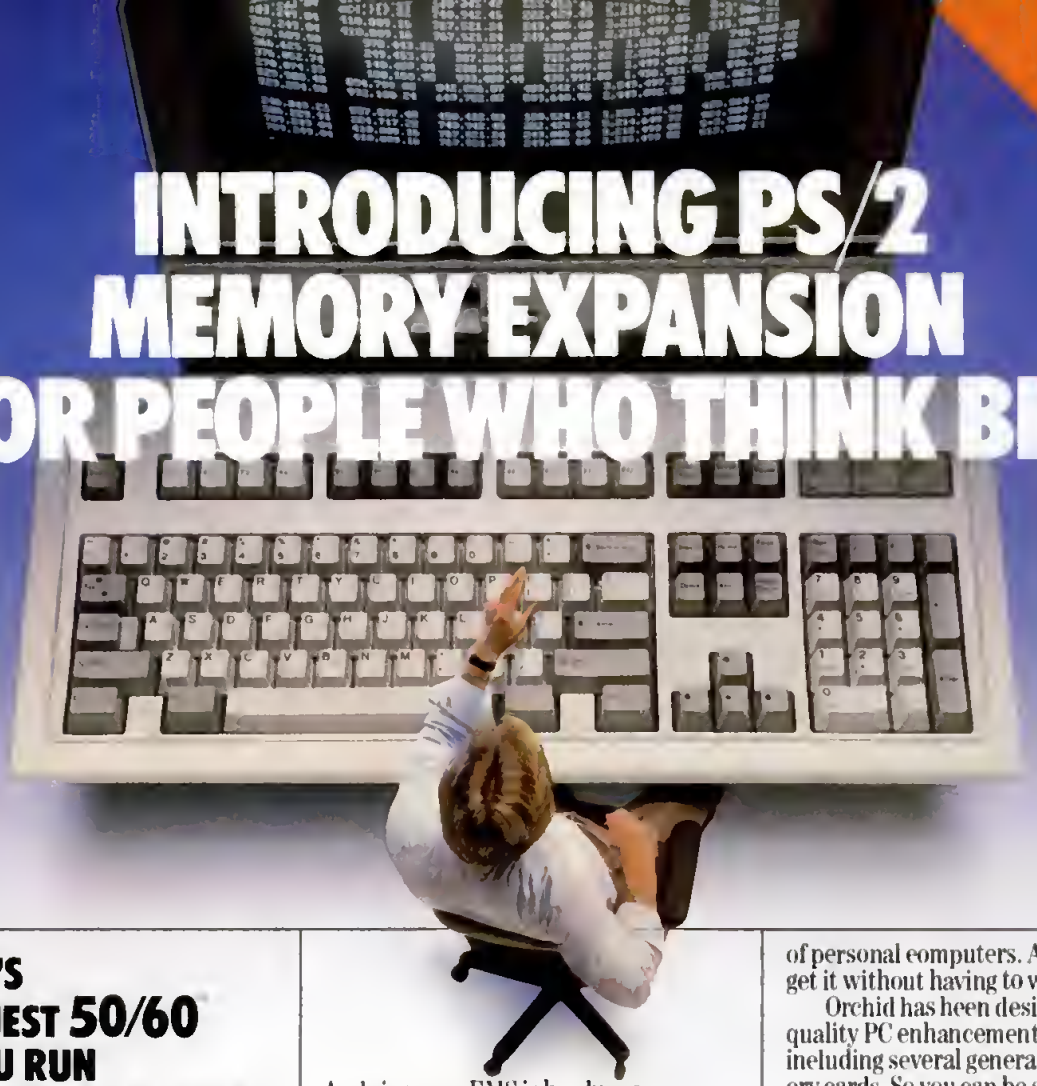
INTRODUCING PS/2 MEMORY EXPANSION FOR PEOPLE WHO THINK BIG.



ORCHID'S RAMQUEST 50/60 LETS YOU RUN BIG-TIME APPLICATIONS ON IBM'S PS/2.

If you try to use an IBM Personal System/2 for serious computing, you'll be disappointed. Because its 1 Megabyte of RAM is only a fraction of what you really need.

But now, Orchid's RamQuest 50/60™ fills that need. It lets you use all the high-performanee programs you already know how to run. Without learning new software.

THE RAMIFICATIONS OF 2 MEGABYTES.

RamQuest 50/60 adds 2 Megahytes of RAM to your PS/2—and gives you a clear growth path for future expansion. So now you can conduct larger Symphonies. Or break out of small Frameworks. And run 1-2-3 as though it were ONE-TWO-THREE.

PLUS FASTER EMS MEMORY.

RamQuest 50/60 conforms to hoth the extended memory and Lotus®/Intel/Microsoft® Expanded Memory Speeifieations—letting you aceess as mueh memory as your system allows.

And since our EMS is hardware-implemented, you ean address huge memory workspaees, and run programs faster.

RAMQUEST 50/60 SPECIAL FEATURES	
Type:	IBM PS/2 Model 50/60-compatible memory card
Capacity:	2 Megabytes of RAM
Standards:	EMS and Extended Memory standards
Productivity Tools:	RAM Disk, Disk Cacbing, Print Spooling
Software Compatibility:	Lotus 1-2-3 V2.0; Sympbony V1.1; Microsoft Windows; Framework II

ALL THIS, AND PRODUCTIVITY TOOLS TOO.

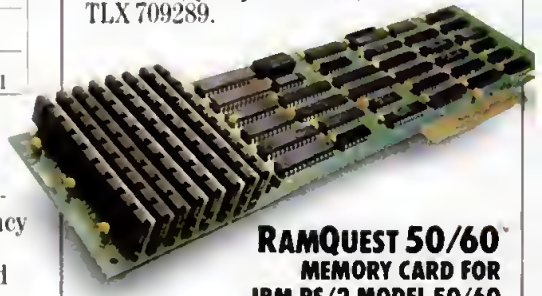
RamQuest 50/60 features produetivity tools that ean boost the effieiency of your PS/2 dramatieally. These inelude RAM Disk, Print Spooling and Disk Caching software—utilities that free up your computer. So you ean keep on working while they handle slow devices like disks and printers.

THE FIRST PS/2 MEMORY CARD, AVAILABLE TODAY.

Orchid's RamQuest 50/60 is the first card from a leading supplier to add this mueh power to IBM's new series of personal eomputers. And you ean get it without having to wait.

Orchid has heen designing high-quality PC enhancements for years, ineluding several generations of memory eards. So you ean be sure the RamQuest 50/60 uses proven technology.

Which explains why we continue to be a leading supplier of add-on solutions for personal computers. For details on our full line of memory, accelerator, graphics and network cards, eontaet your loeal dealer or Orchid Teehnology, 45365 Northport Loop West, Fremont, CA 94538; **(415) 683-0300;** TLX 709289.



RAMQUEST 50/60™
MEMORY CARD FOR IBM PS/2 MODEL 50/60

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TE 0256 479898
TLX 946240
REF 19023380

ORCHID

CIRCLE 492 ON READER SERVICE CARD

QUICK LOOKS

See More: A 1-2-3 Screen Scruncher

PC HANDS ON

BY GUS VENDITTO

Anyone currently suffering eyestrain will now want to avert their eyes while we seize control of the screen and nearly double the number of figures that *1-2-3* has on display.

Doesn't look right? Reverse the video from white-on-black to black-on-white. Change colors if you've got 'em. Still can't see enough of that 87K-byte budget analysis? Zoom out again until the figures are so small, your accountant will have to press his nose up against the glass if he wants to create an audit trail.

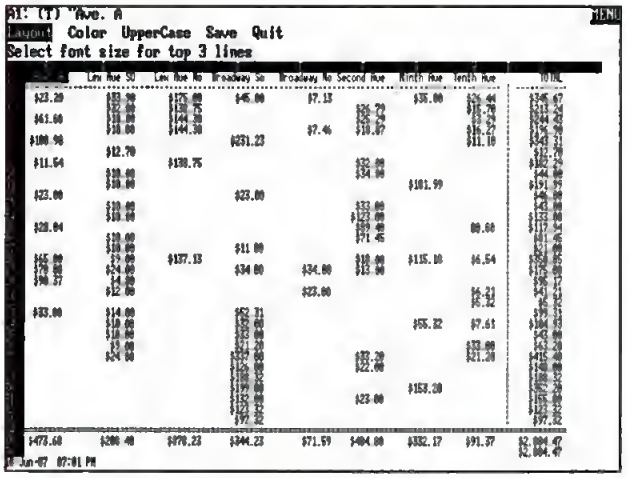
It's more than good clean fun with the latest add-in toy for *1-2-3*, Release 2. *See More for 1-2-3*, from Personics Corp., is the program that removes the burden of navigating around mammoth worksheets from your index finger and places the strain squarely on your eyes.

See More substitutes a graphics mode for *1-2-3*'s character-based display. You get a choice of three type sizes: medium (which is *really* small), small (which is *really* tiny), and tiny (which is downright infinitesimal). *See More* lets you switch among standard 76-column by 40-row screens with either a 102- by 38-, 124- by 38-, or 156- by 53-character display on EGA systems. CGA gets as dense as 124 by 28, but Hercules systems can display an amazing 176 by 53 characters. Commendably, *See More* has the option of keeping the command line normal size or reducing it, and it lets you print condensed worksheets.

It's a handy tool to have around. Not only can you get the *big* picture, but you'll get an early warning of any trouble developing with your eyes.

List Price: *See More for 1-2-3*, $79.95. **Requires:** *1-2-3*, Release 2.0 or later; CGA, EGA, or Hercules adapter. Not copy protected. Personics Corp., 2352 Main St., Concord, MA 01742; (617) 897-1575.

CIRCLE **444** ON READER SERVICE CARD



See More for 1-2-3's small mode lets an EGA system display 124 columns by 38 rows; you can keep the command line normal size or shrink it, too.

Grid Aids Printers in Filling Out Forms

PC HANDS ON

BY CATHERINE D. MILLER

I do almost all my writing on a PC. But when it's time to fill out my expense report, I have to pick up a pen. Computing Aids' *Print Position Aid*, a simple tool that determines print locations, has the potential to automate even that difficult chore.

Print Position Aid consists of six transparent 11- by 15-inch clear plastic sheets, marked with grids. You place a printed form underneath a grid and use the markings to determine how you should set margins, tabs, and line spacing in your word processor to fill in form blanks accurately.

A simple idea that could help filling out standard forms with a PC printer. But *Print Position Aid* helps you win only half the battle: you still need to format your word processing files.

I complete one expense account form a month, so I'll stick with a pen. But *Print Position Aid* is a helpful tool for those who fill out forms every day.

List Price: *Print Position Aid*, $49.95. Computing Aids Inc., P.O. Box 227, Needham, MA 02192; (617) 444-3853.

CIRCLE **445** ON READER SERVICE CARD

dBASE on Video: A Beginner's Tale

PC HANDS ON

BY ROBERT BARNETT

Managers who find employees whiling away the afternoon watching videos can be sure that entertainment is not the goal if the video running is Learn-PC Video Systems' *dBASE III Plus: Beginning and Intermediate Skills*, a 3-hour, 41-minute tape. This marathon session sticks to the facts and avoids any notion that learning *dBASE* might be fun.

Tailored for those who have no PC experience, most of the videotape's first lesson consists of an introduction to the PC.

Lessons cover creating, retrieving, modifying, and sorting a database, as well as designing and printing reports. The tutorial starts its instruction in assist mode but guides the viewer smoothly to command mode, in which most of the instruction is performed.

The videotape scores high marks for its instruction method. Fundamental concepts are reinforced through verbal explanations, demonstrations, and instruction screens. The tutorial is interactive and provides ample opportunity for viewers to practice *dBASE* operations.

Viewers with little or no PC experience who desire slow, steady, step-by-step explanation will greatly appreciate the pace of instruction. Seasoned PC users should skip the introductory lesson and fast-forward to the *dBASE* material.

List Price: *dBASE III Plus: Beginning and Intermediate Skills*, $695.

Requires: 256K RAM, VHS or Betamax player, *dBASE III Plus*, DOS 2.0 or later. Learn-PC Video Systems, 1525 Glenwood Ave., Minneapolis, MN 55405; (800) 532-7672, (612) 377-2222.

CIRCLE **446** ON READER SERVICE CARD

PC UPDATE

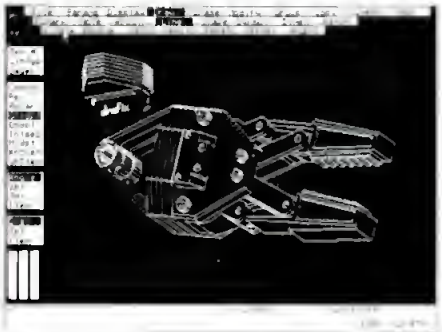
edited by Peggy Gavan

Intel 80386 Microprocessor

A manufacturing snag in the **Intel 80386** microprocessor, which only affects operations in protected mode, caused a slowdown in chip production and forced Intel Corp. to reduce the number of chips allocated to existing customers. Also, the company has made a new blueprint, or mask, for the chip, and is rescreening 80386s that have already been shipped. Customers who bought an 80386-based PC or add-on board prior to April 10 can have the chip retested (and if necessary, replaced) by returning the chip to the vendor who sold it to them. Users who believe their machines are affected should contact their dealer. Intel Corp., Santa Clara, Calif.; (408) 987-8080.

drafix 1 Plus

drafix 1 Plus adds several new features and enhancements, including a pop-up text editor, function key macros, splines and bezier curves, and freehand sketching. In addition, two *drafix* modules, DotPlotter and General



drafix 1 Plus *adds a pop-up text editor, function key macros, and freehand sketching for $45 to registered users.*

Symbols, are now included with the program at no extra charge. *drafix 1 Plus* is priced at $295; upgrades are $45 for registered users. Foresight Resources Corp., Lawrence, Kans.; (913) 841-1121.

Disk Technician Put to the Test

Our tests of *Disk Technician*'s ability to save CMI hard disks in an IBM PC AT have been under way at *PC Magazine* since our review of that product appeared in First Looks (page 48, Volume 6 Number 12). One surprise finding was that although *Disk Technician* program files can be copied, the original disk is required for normal operation and so the program is, in effect, copy protected.

The testing routine included continuous random reads and writes, broken only by a periodic run of *Disk Technician*'s own daily test. After 120 hours of steady use, the disks seem to have been saved. However, about 15 hours of work with *Disk Technician* was required to fix each disk. —*Mitt Jones*

CompuServe

Daytime connect rates for the CompuServe **Information Service** have been reduced to the same as evening and weekend connect rates. Subscribers may now access the service anytime for $6 per hour at 110 to 450 bits per second, and for $12.50 per hour at 1,200 to 2,400 bps. CompuServe, Columbus, Ohio; (614) 457-8600.

Compaq Deskpro 286, Portable III, Portable II, Deskpro

Compaq Computer Corp. is now providing disk caching as a standard feature for hard disk drive models of the **Deskpro 286**, **Portable III**, **Portable II**, and 8086-based **Deskpro**. Current owners can get the utility from Compaq dealers. Also, the company has cut the prices of its Portable II, models 2 and 4, by $300 and $500, respectively. Compaq Computer Corp., Houston, Tex.; (713) 370-0670.

IN BRIEF

Zenith Data Systems has increased the RAM from 256K bytes to 512K and has reduced prices by $300 on its line of **Z-159** PC compatibles. New prices range from $1,449 for the Model 1 to $2,499 for the Model 13. Zenith Data Systems, Glenview, Ill.; (312) 699-4839 . . . ***Graph-in-the-Box***, Version 3.1, is not copy protected and has a new $99.95 price. Registered users of the protected version can upgrade for $15. New England Software Inc., Greenwich, Conn.; (203) 625-0062 . . . Okidata has reduced prices on its **Laserline 6** printer and single-user **HP Laserjet Plus Advanced Interface** by $200. The new prices are $1,795 and $200, respectively. Okidata, Mount Laurel, N.J.; (609) 235-2600.

PS/2 WATCH

STB EGA Multi Res, Chauffeur HT

STB Systems is offering a ROM BIOS replacement for its **EGA Multi Res** video adapter that adds **VGA** 640 by 480 resolution in 2- and 16-color modes on multisync monitors. The price of the adapter with the new BIOS is $399; current owners can purchase the chip for $25. In addition, STB is shipping drivers for *Microsoft Windows*, *1-2-3*, Releases 1A and 2.0, and *Symphony* with its **Chauffeur HT** video adapter, priced at $249. STB Systems Inc., Richardson, Tex; (214) 234-8750.

PC PageMaker

PC PageMaker, Version 1.0a, includes a runtime version of ***Microsoft Windows***, Version 1.04, and the drivers needed to work with IBM's new **MCGA** and **VGA** graphics modes and the IBM mouse. Upgrades are $10 for registered users. Aldus Corp., Seattle, Wash.; (206) 441-8666.

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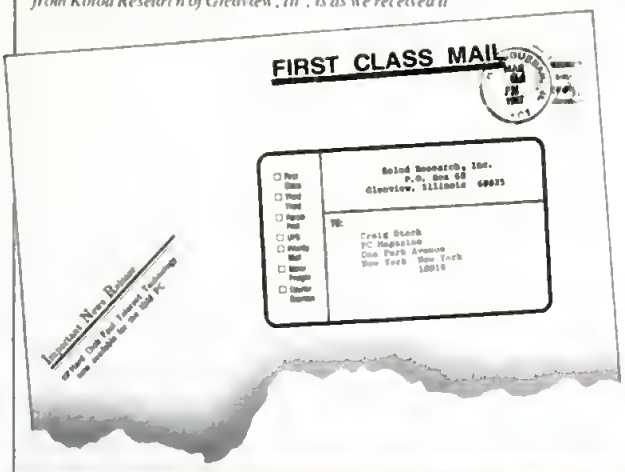
CIRCLE 169 ON READER SERVICE CARD

COMMUNIQUÉS

edited by Bill Howard

The words "Important News Release" on the outside of an envelope always make editors sit up and take notice, especially when combined with a pointing finger. This label from Kolod Research of Gleaview, Ill., is as we received it



Classified Intelligence

Caroline's Altos Sales & Massage Parlor: Free two hour consultation with each purchase of an Altos 486. Limit one customer per consultation. Box xxx. Altogether, Box xxxx, Sioux City, Ia. 51104

—Altogether *(Altos user publication), April 1987*

PC board stuffer. Must be under 5 ft. in height. Resume only: Salem Technical Services . . .

—Houston Chronicle, *May 24, 1987*

Quicksilver & dBXL, the fastest dBASE III + compiler & super clone from Wordtech featuring network window & extended language. Tel xxx-xxxx for demon.

—The Straits Times, *Singapore, May 19, 1987*

Lotus 123 Spread sheet auditor 123, and report writer 123. Hardly used. xxx-xxxx

—Kansas City Times, *April 30, 1987*

Why buy an IBM XT clown? When you can buy a Brand Name [Sanyo] Computer at same price. MBC-16 640K RAM/DRIVE TURBO 4.77/8Mhz Dos 3.2 ....$999

—Computers Plus ad, The Calgary Herald. *May 15, 1987*

Comdex Trivia from Atlanta

Highlights of Spring Comdex, the industry's second biggest show (after Fall Comdex), held June 1 through 4 in Atlanta:

Bizarre mave na. 1

Moving the date from April to June, when Dixie goes hot and humid. Was it an attempt to administer the coup de grace to the all-but-deceased National Computer Conference by holding it the same month?

Bizarre mave no. 2

Holding Comdex the same week as the Consumer Electronics Show in Chicago. There's enough overlap among exhibitors, writers, and showgoers to frost the ones who wanted to be in both places.

Best parties

Alabama (Intelligent Systems). Great music, and further proof that good ol'e boys can't dance on stage.

Four Tops (NEC)

Jam session (*PC Magazine*). The industry's brightest lights know their music, too.

Beach Boys (DCA). Fun, fun, fun.

Toshiba Toshibar. Shrimp, shrimp, shrimp.

Best giveaways

1. Cash grab, Distribution Plus. The Frederick, Md., distributor put $10,000 in bills and a blower in a glass booth and let contestants grab as much as they could in 10 seconds.

2. *Sgt. Pepper* CDs, Number Nine Computer Corp., Cambridge, Mass.

Sad slogans from companies that shauld know better

"The new Microsoft Mouse: It's pointing the way to the future . . . with twice the resolution of other mice."

—Microsoft. Its mouse resolves 200 dots per inch, but so do most all other mice.

"Eliminate a glaring problem."

—Polaroid glare shields

Great software we saw unveiled

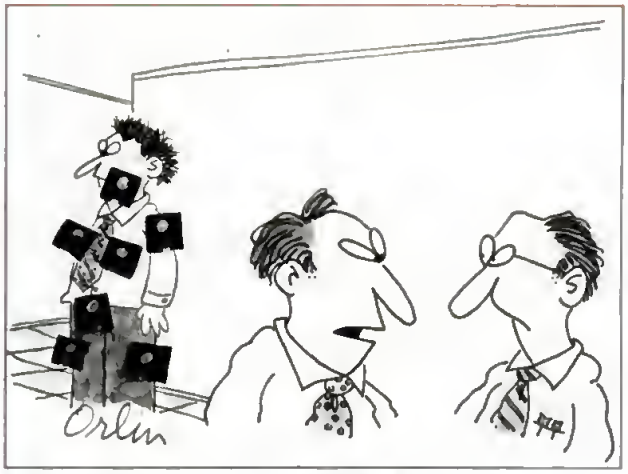
1.
2.
3.

Famaus nanexhibitars (helping ta explain 1, 2, and 3 above)

1. Microsoft
2. Lotus
3. Borland
4. MicroPro
5. Compaq
6. Tandy

Best prediction

At a panel on the 386, analyst Will Zachman said UNIX with DOS as a sub-task could be a hot operating system.



"Maybe we should tell the infocenter they haven't licked the static problem yet."

Heard or seen anything offbeat, unasaal, or just plain damb about the computer industry? Send your offerings to Communiques, PC Magazine, One Park Avenue, New York, NY 10016, or MCI Mail 157-9301. Contributors receive $50 and a PC Magazine T-shirt. In case of duplicate entries, the earliest postmark prevails. Sorry, but entries can't be acknowledged. Please include the name and issue date of any newspaper/magazine clippings. And please, don't send classified ads for sloppy drives, leather quality printers, or cereal interfaces.

Winners this issue. Craig Stark (news release), Lois Kockler (massage parlor), Sally Whitener (board stuffer), Sum Kok Meng (compile demon), Michael Bellino (123 hardly used), Don Hobsbawn (XT clown).

Illustration Richard Orlin

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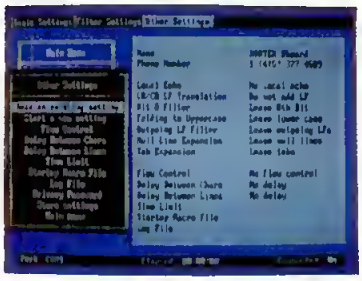

Automation: You shouldn't weste your time with simple chores. So Freewey eutometes your communicetion. It stores over 20 settings for each host you cell in its Phonebook. If e number is busy, Freeway will redial until you get through. And, in addition to the Autopilot, Freewey includes e powerful ecript fecility, with eccess to ell Freeway's feetures. For instance, a script cen weit until 2 e.m., cell e BBS, check for mail, end downloed eny new files, leeving you an exect trenscript.

Control: Freeway gives you fer more detailed control than just the usual beud rete and parity. You have seven filters for incoming end outgoing text. You can specify the cherecters used for flow control, end the length of e Breek. In ell, you heve control of over 50 settings, most of which can be different for each phone number.

And remember, just because Freeway is powerful, doesn't meen it's difficult. The edvenced features ere es eccessible es the besics, via fest menus with keyboerd shortcuts.

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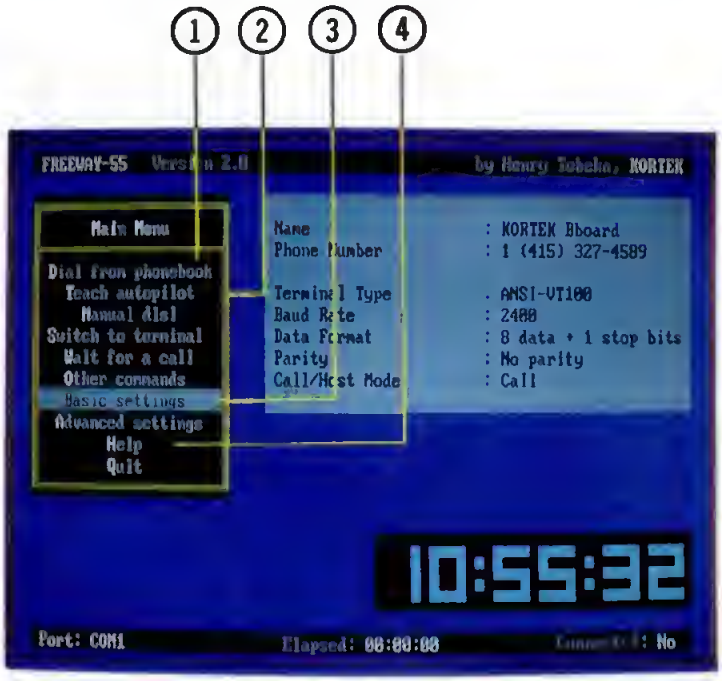
Take Freeway's simple menus and clear displays. Add the arrow keys and the Escape and Enter keys. The result is powerful but straightforward communication — at your fingertips.

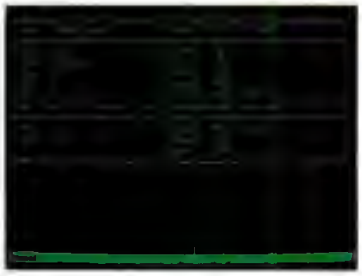


1 Phonebooks: Freeway lets you store the phone numbers (and other settings) for up to 100 computer systems. You just use the arrow keys to pick the number you want, hit Enter, and leave the dialing to us.

2 Autopilot: Computer communication is more than just placing a call. You have to log on to the other computer, and often type introductory commands. Freeway provides an "autopilot" to relieve you of this chore. You simply go through these preliminaries once, with the autopilot noting your every move. Then, when you next call, the autopilot will do the work for you.

3 Setting Up: Setting up Freeway is a piece of cake! The parameters you need — baud rate, parity, and even the number to call — are gathered in simple menus. To set them, you just zip through with arrows and Enter, and then save them in the Phonebook. Later, changing one or all of them is just as easy!

4 On-Line Help: Even though Freeway is very easy to use, we all need a hint now and then. Every line of every menu has on-line help at the touch of a key.



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—George Goley, Data Based Advisor, November 1986.

"FoxBASE+ stands out from the competition as a nearly ideal environment for dBASE III PLUS applications . . . easily the fastest dBASE III PLUS compatible program . . . a must-have product."
—Nicholas Petreley, InfoWorld, May 18, 1987.

"We now have one answer to the eternal question, 'Which dBASE is fastest?' The answer is clearly FoxBASE+."
—Adam B. Green, dBASE Performance Guide, Spring 1987.

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■ FROM THE EDITOR'S SCREEN ■ BILL MACHRONE

THINKING ABOUT THE PS/2

Despite all the hoopla, IBM isn't blowing anything past our readers. A survey of our readership shows that you're an opinionated lot, especially about the PS/2s.

The results are in. And they're surprising. We took a survey in mid-April on the PC Magazine Interactive Reader Service. Readers who call in to download programs from PC-IRS have the opportunity to voice their opinions on a wide variety of topics. We always have a survey or two running.

This one was special, because it was the first chance for you to express what you really thought of the new IBM machines. In 5 business days, 834 of you shared your perceptions with us. Of course, many of you are still evaluating the machines, and your perceptions may change. So we'll have run this survey again by the time you read this (we wouldn't want you to stuff the ballot box, after all). PC Labs has given the machines a thorough going-over, we've published the results, and you've had time to look at the machines in more detail. But first reactions are lasting ones and that is what this survey is about.

The first question we asked was, "In what way have the IBM announcements affected your corporate buying plans?" Twenty-nine percent of you said that you were holding off on buying until you figured out the implications, while 6 percent had already decided to buy the new PS/2 series. Twenty-five percent were evaluating IBM as well as other vendors, and another 25 percent found that the price/performance ratio of compatibles was better. The final 15 percent gave other answers. Some of the responses:

"Our primary consideration is portability; Compaq wins."

"I work for IBM."

"We're covered under the government's Zenith Z-248 contract."

"Without OS/2, it's no big deal."

"We are a little slow at the top, but I'm pushing to buy."

We then asked, "Which of the new systems interests you the most?" We limited the selection to the three machines currently available. While I continue to predict that the Model 50 will be the volume leader, the technical bent of *PC Magazine*'s readers caused 41 percent of the respondents to choose the Model 60. The Model 50 followed with 30 percent, and you proved your intelligence by relegating the Model 30 to only 7 percent. Interestingly, 22 percent said, "None of the above."

Three questions dealt with integration. With more than 8 million PCs already in the workplace, new disk drives, video, and bus architecture face obvious roadblocks. For example, 31 percent of the respondents said that 3½-inch disks "will be a major obstacle and we don't want to deal with it." Another 41 percent opined that, while there would be problems, they would integrate anyway. A breezy 28 percent said, "We don't think it will be any problem and we're ready to begin."

On the video side, 11 percent said that the new standard would be a major benefit, and 26 percent said that, while it would be a benefit, it would not be a major one. The largest group, 44 percent, declared that the new standard makes no difference. Fifteen percent said it was a detriment, but not a major one, and 4 percent said it was a major detriment.

MICRO CHANNEL MATTERS In the same vein, 10 percent felt that the new Micro Channel Architecture was a major benefit, and 22 percent said it was beneficial but not in a major way. Forty percent said it made no difference, a strong testimony to their belief in the aftermarket. Sixteen percent thought it was somewhat detrimental, and 12 percent said that it would be a major detriment.

The next logical question was, "What actions will you take to upgrade your installed base?" A significant 13 percent said they would add 3½-inch disk drives. Only 2 percent said they would upgrade to analog video boards and monitors. The number who said they would upgrade to DOS 3.3 was surprisingly low, at 18 percent. And a stolid 50 percent said, "We don't intend to upgrade." A final 17 percent answered "other" and gave explanations. They ranged from an ebullient "VGA is the way to go!" to a testy "We

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■ EDITOR'S SCREEN

don't consider the new systems an upgrade." Some responses show clearly that IBM isn't the only player: "OS/2 with *Windows* will be the determining factor—we'll see." Or, "Our upgrade path will follow Compaq's lead, not IBM's."

CLOUDY CRYSTAL BALL The PS/2 line was preceded by a lot of rumor and speculation. Some of it raised expectations for some people, while it lowered expectations for others. In fact, 14 percent of the respondents said the systems were much less than they had expected. Another 22 percent said that the systems were less than they had expected, while the largest group, 43 percent, held that the systems were about what they had anticipated. Eighteen percent said the systems were better than they had hoped for, but the group managed, overall, to contain its enthusiasm: only 3 percent said that the systems were much better than expected.

We rounded out the survey by asking our respondents how large a company they worked for. Twenty-six percent have fewer than 10 employees. Twenty percent have from 10 to 100 employees, while 14 percent fall into the 100-to-500 bracket. A whopping 40 percent work with more than 500 employees.

So it isn't exactly love at first sight for our readers and the PS/2 lineup. But there appears to be a grudging acceptance of the new ideas and standards. Some of the reactions are surprising, such as the low number intending to upgrade to DOS 3.3. This latest version of DOS has more to offer than the last several revisions. It is much less buggy than the initial release of DOS 3.2 (indeed, many users reverted to 3.1) and it is noticeably faster. It also has some handy new commands, notably Fastopen and Append. The disk caching program comes with the machine, not with DOS, but will find wide application.

Also, we may all be underestimating the speed with which 3½-inch drives move into prominence. Compatibles will soon appear in the new format and 3½-inch software is already being distributed. Portables are already a good reason to buy 3½-inch drives. And we can all use the additional storage in a superior package.

Other than that, I think your perceptions are right on the money. PC

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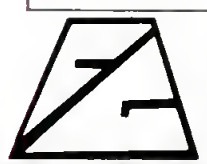

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CIRCLE 110 ON READER SERVICE CARD

■ JOHN C. DVORAK

SAD CURES FOR USER IDIOCY

Software developers come up with an endless number of ways to help the naive microcomputer user along. But some of the remedies are more trouble than they're worth.

There is a lot of junk available for the user of today's microcomputer. By junk, I mean useless software. This sad fact dawns on me whenever I dive into Uncle Johnny's Giant Pile of Software.

There seem to be three major categories of useless software that stand out. Interestingly enough, the companies that make these products all hope to cash in on the same market: the naive user, the bonehead.

The first product in this group is the so-called DOS shell. If you don't know, a DOS shell is a program that takes over the screen you would normally see when you run an IBM computer. Instead of the simple A> prompt, you see a screen full of lists and details about the system that supposedly make your chores easier. Instead of, say, typing 123 at the prompt, you scroll around a huge menu of files and highlight the Lotus file. Then you hit the Return key, a function key, or some letter on the keyboard and the program executes. It seems much simpler just to type 123 at the A> prompt, if you ask me.

The idea of a shell is beneficent but patronizing. It hopes to make the life of a computer user easier. Instead of having to remember the complex instruction DIR when you want to list files on a disk, you can highlight something on the shell program and it will list the directory for you. By its very nature, a DOS shell assumes you are a complete dolt. I suppose they are of some value for the genuine dolts out there. No offense to those users who love these things. Ahem.

Anyway, a new DOS shell seems to come out each week, and I get every one of them with a note attached that says, "John, I know you don't like DOS shells, but I think you'll find that *XYZ* shell is different . . . blah, blah, blah." They never learn.

A competing product type is the on-line help facility. This is a program that may be of some use to the rank amateur for at least a little while—probably a week. It is essentially the IBM PC-DOS operating system manual on disk. When you have a problem you type HELP (or universally hit function key F1) and you are walked through a long series of menus, lectures, and explanations. In short, you learn how to type DIR at the prompt to get a directory. Asking a friend to show you the ropes is the better way to accomplish this difficult learning feat.

The latest iteration of these programs uses the catchphrase "context-sensitive help," meaning the program looks at the cursor, sees what word it is on, and tries to find a help file specific to the word. If you were on the word Exit and triggered help, it would explain what Exit meant (maybe).

Illustration, Karen Stopler

Finally, there is a group of products I like to call menu and annotation generators. The menuing programs are designed to be used by a corporate MIS/DP guy who is setting up a limited number of applications for use by some department. The assumption of this software (and of the MIS department) is that the users will run only a few specific applications, ever.

The typical "approved" menu comes up when the machine is turned, on and it says: "Do You Want To Do (A) Word Processing, (B) Lotus, (C) Print the Directory of Files, (D) Quit." For this creation the MIS/DP guy gets $75,000 a year.

Worse than the menu generators are the annotation programs. These are programs that combine the worst features of the help programs and the mentality of the menu generators. It encourages some boob to add custom help screens that annoyingly pop up everywhere. The screens are generally written by an MIS guy or an engineer who can't write for beans. In other words, instead of buying the help program mentioned above, the MIS guys write their own help files as though they can do better. I suppose it looks good on their resumes.

Someday some sharp operator will combine all these ideas into one grand program—the menuing annotation and help DOS shell program (MAH DOS). Any guesses as to what I'm sure they'd leave out? A way to list the directory.

My advice: buy a book.

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CIRCLE 245 ON READER SERVICE CARD

■ JOHN C. DVORAK

INSIDE TRACK

Intel's shortsighted new policy, and buzzwords to describe the state of the art in LCDs.

These are the dog days. Everything for the next month or two will be dull. Dog days begin after Spring Comdex (see my complete report in the next issue of *PC Magazine*) and end in November when the companies gear up for Fall Comdex. Until then the hot action for hardware vendors is hoping they can get **24-MHz 80386 chips** so they can make that no-wait-state static-RAM speed-burner that we can expect to see by the boatloads if all goes well.

All isn't going well. As of this writing, AMD is still struggling with Intel in hopes of retaining its technology-exchange agreement so that it can second-source the 80386. As I've mentioned before, Intel has decided to single-source the 80386.

All the licensees have been booted off the list except for IBM (and it doesn't count). Only AMD is fighting it.

Few end users realize how important it is that Intel relinquish its desire to sole-source the 80386 chip. Old-timers will tell you over and over that if you don't have multiple sources for a chip, then you shouldn't design a system around it.

Reliance on a single source has spelled **disaster** for more than a few firms.

My favorite example was the **blunder made by a defunct pioneering company called IMSAI** when it got into a single-source arrangement for its long-forgotten 8085-based line of microcomputers. Then-owner (later to become founder of Computerland and get himself into all sorts of hassles) Bill Millard was told by his engineers back in 1978 or so that the **next hot chip** was going to be the Intel 8085. This happened just as the Z-80 was taking the world by storm. So Millard took their not-so-sage advice (while the customers were screaming for the Z-80).

To use the 8085 meant you used a lot of single-source parts. Meanwhile, the Z-80 and its support chips were all over town, sourced by everyone. During an important production run, Intel couldn't supply some of the chips for the system. IMSAI couldn't finish any machines but was expected to pay its bill to Intel and wait for the back order on its own nickel. One thing led to another, and **the company folded** during a cash-flow crunch.

This type of crunch is common with single-source deals. Something goes wrong and **the company is at the mercy** of the source.

So why did Intel recently pull its second-source agreements from all the other makers? **Nobody will make the 80386 chips** (and many vendors already stopped making 80286 chips) except Intel if Intel has its way. The rationale is obvious. More loot. Easy money.

At this point in my story, I must note that AMD has a special deal with Intel, and their contract, if there is a dispute, **calls for arbitration**. Hopefully this will be cleared up by the time you read this, *and*, hopefully, the ruling will favor AMD.

If the 80386 remains a single-source item, then you can be sure Intel will single-source all its future microprocessors, and the **paranoid designers** will look elsewhere fast.

Where will they look? Well, if they don't want to go with the powerful Motorola 68020 and 68030, then they will look to **Tokyo**. By this I mean the NEC chips, namely the V-60 and V-70, for starters. These are the major players in the design wars: Intel, Motorola, and NEC. (Forget about National Semiconductor; it can't get any big shots to use its microprocessors. A microprocessor without popular support, no matter how powerful, is nothing more than a **footnote** in the history of design.)

Anyway, the V-series is Intel-inspired architecture and a **threat to Intel's dominance**. Intel can maintain dominance only if the market is flooded with its microprocessors, and that can't happen if it insists on thinking it can get away with single-source nonsense.

This is the beginning of a long battle for the next year or two. It may mark the **beginning of the end** for the current basic architecture of the desktop microcomputer. Designs using chips called transputers, and even using discrete logic, are being invented and tested. Giant gate array computers that **emulate microprocessors** are on the drawing boards. Perhaps Intel sees that the road ahead for the microprocessor is a rough one and wants to make as much as it can while it can. Whatever the case, it may be accelerating the process and even **signing its own death warrant with its newest policies**. End of diatribe #416.

While on the Subject of Intel Dept.: After suggesting in Volume 6 Number 11 that Intel may release an 80387 chip that fits into the 80287 socket, I got an anonymous letter from an Intel employee. Simply put, the employee **said I was nuts.** Thought you should know.

Impress Your Friends Dept.: The new buzzwords to describe the state of the art in LCDs is not supertwisted or birefringent. Those were last year's buzzwords. Now it's "cyanobiphenyl." That's the new material used to create display that is viewable from 180 degrees with **knockout high contrast**. Try that tongue twister at your next party.

I Keep Wanting to Mention This Dept.: Those of you who are Source subscribers: type DVORAK at the system prompt. Yes, it's where you get to read more Dvorak. Such a life. PC

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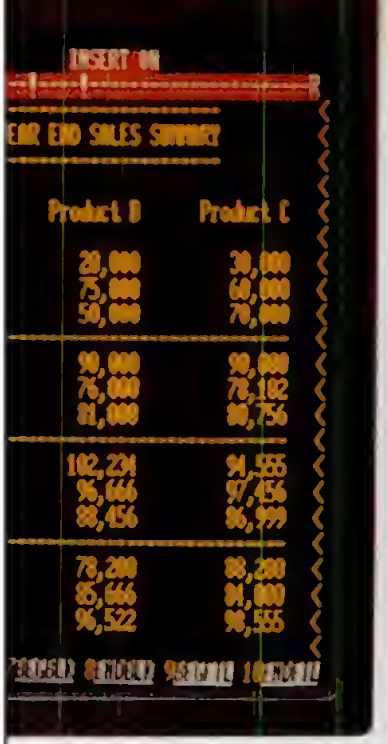

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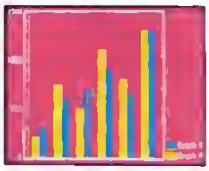

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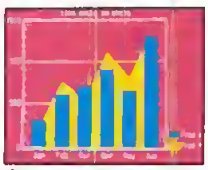

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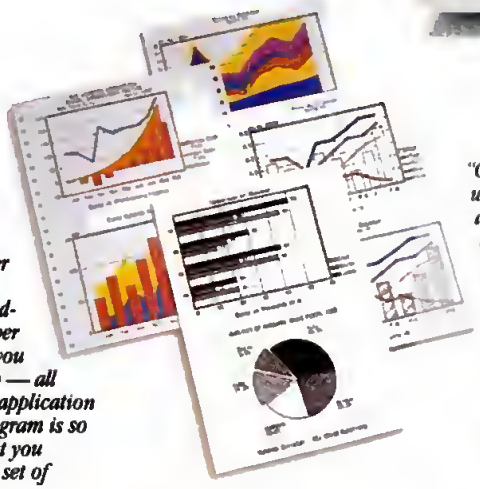

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Minimum Hardware Requirements: All Dac-Easy Products run on IBM or compatibles, two disk drives, MS-DOS or PC-DOS 2.0 or later, 80-column printer able to print 132 column in compressed mode, color or monochrome monitor, 256K memory (Dac-Easy Mate requires 384K).

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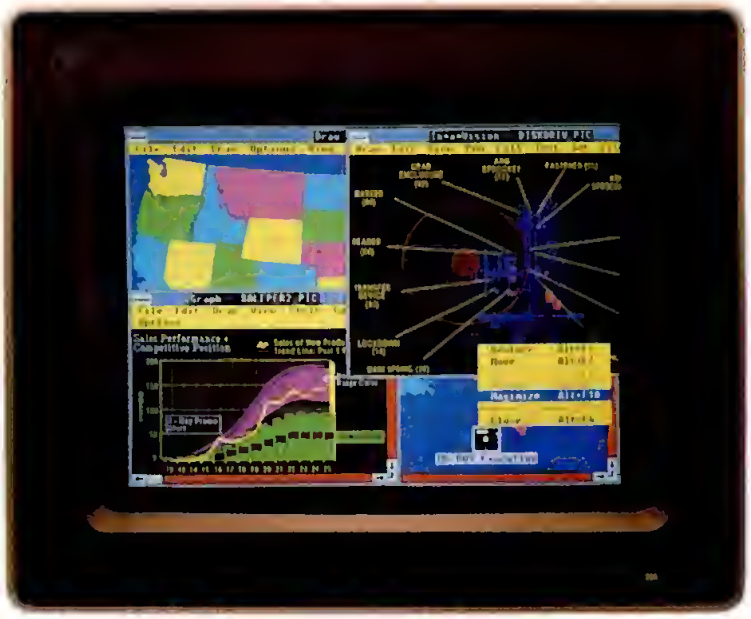

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In*a*Vision is a powerful, easy-to-use Computer Aided Design (CAD) program. In*a*Vision was the first Windows-compatible program and according to PC Magazine (June, 1987), "In*a*Vision is still the best Windows-specific application." In*a*Vision is ideal for design professionals. Whether you are creating complex technical drawings, schematics, flowcharts, floor plans, organization charts or designing your own new kitchen, In*a*Vision makes your job easier.

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With Windows, each Micrografx application can run in a window simultaneously with any other Windows application. And Micrografx' applications are data compatible with all other Windows applications through the Windows Clipboard. A common user-interface, pull-down menus, mouse support, shared device drivers and our common "object-oriented" file structure gives you consistent ease-of-use and top-quality output. Our PostScript and PageMaker compatibility means that all of the graphics you create are perfect for desktop and professional publishing.

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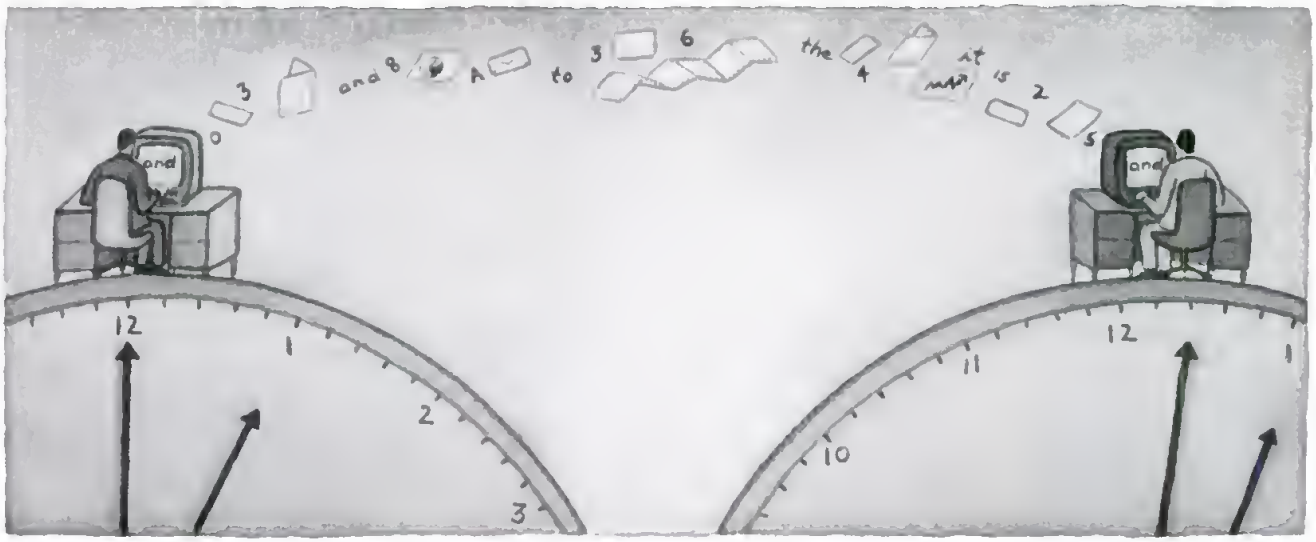

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Minutes later, your message or file arrives at its destination in usable and revisable form—formulas and formats intact.

Save time, money and trouble.

With Lotus Express, there's no complicated communications software to learn. And no need to alert the receiving party, or sit by your PC while messages are being sent or received. What's more, Lotus Express lets you maintain local mailing lists on your PC.

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All you have to do is read them. And that's easy too, because Lotus Express indexes your messages by date, time, sender, and subject. Just highlight the message you want to read and press "return." What's more, you can file your messages, in "folders" that you create, with index information readily visible on a summary screen.

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*Electronic mail allows the sender to compose a message and send it to another person's computer "mailbox." The receiver merely checks his/her mailbox, reads the message, and then responds in the same way.

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CIRCLE 541 ON READER SERVICE CARD

■ JIM SEYMOUR

ink. Nor did it inspire very many screen drivers.

But Lotus looked and listened, and it supports RAMfont with *Manuscript*. With the Hercules card, *Manuscript* can now show character attributes in its page-preview mode. And it's acceptably fast.

So I'm back in the monochrome world, back using a fixed-scanning-rate monitor, in non-WYSIWYG . . . and loving it.

Case No. 3: I have, use frequently, and love dearly a Toshiba T3100 lap-portable. It's a full-function PC AT in a smaller-than-attaché-case-sized box, and a year after I got it it's still a wonder.

But I don't always *need* all that 80286/DOS firepower when I'm traveling. Sometimes if I'm just gone overnight on a speaking trip, all I really need is a compact, smart terminal with a little memory and a decent text editor built in so that I can log on to MCI Mail and keep up with what's going on at the office. So I find myself still using my old, battered Tandy Model 100 a lot. No offense, Toshiba, just a matter of choosing the appropriate tool.

If there is a common thread through all this apparently retrograde behavior, it's exactly that issue: using what's appropriate. Judging from the actions of legions of software developers, 10 function keys at the left end of the keyboard have become more *appropriate* than 12 strung left to right across the top.

■ I don't always *need* all the Toshiba T3100's 80286/DOS firepower when I'm traveling.

Judging from the actions of the *Manuscript* development team, a crisp, high-resolution monochrome display driven by a Hercules Plus card is more *appropriate* than a NEC MultiSync, which just shows my subheads in blue.

And when my traveling-PC needs consist of sending and receiving MCI Mail, the lightweight, cheap, durable Tandy is a more *appropriate* tool than a Toshiba, which can compute rings around a Tandy.

So maybe I'm not such a throwback after all.

The magic of the new, small, and fast can be considerable. But mismatching the tool to the job—hauling a 15-pound Toshiba 3,400 miles when a 4-pound Tandy Model 100 would have done as well—isn't magic: it's just plain dumb.

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*Electronic mail allows the sender to compose a message and send it to another person's computer "mailbox." The receiver merely checks his/her mailbox, reads the message, and then responds in the same way.

**IBM PC, PC/XT or Portable PC (DOS 2.0 or higher), IBM AT (DOS 3.0 or higher), COMPAQ PORTABLE, PORTABLE II (DOS 2.02 or higher), COMPAQ DESKPRO (DOS 2.01 or higher) or AT&T 6300 (DOS 2.11).

Lotus Express is based on proprietary Lotus Metro™ technology. It is a RAM-resident "pop-up" conducting background communications with MCI Mail. It supports up to 9 mailboxes per PC.

MCI Mail charges $1 for each block of 7,500 characters (3-5 pages) sent. Short messages of 500 (or fewer) characters are only 45¢.

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HOW TO SOLVE THE TEN MOST COMMON BUSINESS PROBLEMS WITH YOUR IBM PC (OR COMPATIBLE)

Solid, Guaranteed Software Products At Honest Prices: That's Software Express/Direct We give you value for your software dollar with exclusive PC/compatible business programs at the lowest possible prices, all backed by our unconditional money-back guarantee. ***Why such low prices?*** Fact is, we sell more software if it's more reasonably priced. Which means you can get more done with your PC during your business day, all for a whole lot less money.

☐1. Mailing Lists And Labels Made Fast And Easy

Now you don't need an expensive and hard-to-use database program if all you want to do is print address labels for your business or customer mailing lists on your PC.

LABELWRITER combines the essential information-handling features you need with versatile printing options to make it easy to maintain and print business mailing lists on self-adhesive, continuous-form address labels with your PC's printer.

LABELWRITER features powerful searching and sorting capabilities for easy printing of labels for all or part of a mailing list file, in last name or Zip Code order.

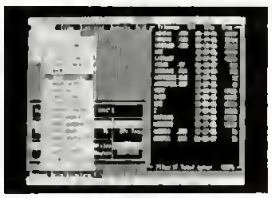
The most common label formats come pre-loaded in LABELWRITER for quick and easy printer setup. With a few simple steps, you can also adjust LABELWRITER to work with any other size and width of mailing label.

With LABELWRITER's useful range of features at an affordable price, you get all the capability you need for fast, easy business and personal mailings.

To order ***Labelwriter***, use Selection Code ***#368441***

Labelwriter **$24.95**

☐2. How To Manage Your PC's Hard Disk



Get the most from your PC's hard disk with REBOUND—the easy, powerful way to organize and control the programs, directories, and files on your PC's hard disk.

REBOUND's exclusive window design gives you lightning-fast, one-key access to all the common DOS "housekeeping" commands on your PC— finding, copying, erasing, viewing and moving files—so you spend more time making your PC work for you and less time learning complicated DOS hard disk commands.

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Whether you're a novice or an experienced PC user, we guarantee that REBOUND will increase your PC productivity every business day. If you have a hard disk PC, spend a few dollars extra on REBOUND—you'll be very glad you did!

To order ***REBOUND***, use Selection Code ***#300071***

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☐3. Three Practical RAM-Resident Business Utilities

The essential programs you need most for the real world of business...WOW! puts a business calculator, daily alarm/scheduler, and print style setter a keystroke away from your spreadsheet, word processor, database or any other program.

WOW!'s practical business calculator puts a multi-function calculator in your PC's memory, ready to be called up at the press of a key. The WOW! print style setter sets up your EPSON/IBM dot-matrix printer to print in any one of seven different type styles, from within any other program. WOW!'s daily scheduler/alarm lets you set up important reminders throughout the day.

With WOW!, you can make a fast calculation while using your word processor. Schedule an audible reminder to make an important call this afternoon, while using your spreadsheet. Or print a letter in any one of seven different typestyles on your EPSON/IBM dot-matrix printer—without having to fiddle with printer codes. And all while using any other commercially available program on your PC.

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WOW! **$22.95**

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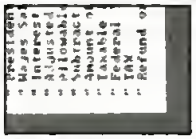
☐***5. Fast Loan Calculations Made And Simple*** our popular LOANPAK's impressive window design does all the standard loan calculations, mortgage tables, etc., plus a missing factor option useful for calculating monthly payments at various interest rates. (E1360143)

☐***6. Make Short Work Of Long-Distance Calls*** with AREA CODE EXPERT, the handy desktop reference for your PC. displays instant area codes for over 300 cities (and vice versa). ACE's fast windows help you make short work out of finding long- distance numbers. (E1370952)

☐***7. Right Financial Tools At Your Fingertips*** get the most common financial calculations in one indispensable package. INVESTICALC combines Future Value, Investment and Annuity Returns, Regular Deposits for Returns and lots more in a fast package that includes report-ready printing. (E1360742)

☐***8. Label And Organize Your Data Disks*** neat labelling of your library of data disks made easy with DISK FILER. Print the filename contents of your disks in reduced size type on self-stick disk labels on your EPSON/IBM dot-matrix printer...a great "get organized" program! (E4300451)

☐***9. Business Letter-Writing Made Simple*** get over 50 professionally written business letters in text file form with DISK LETTERS. Includes letters for many common business situations for any word processing software, so you'll always have the "right words" to get your point across! (E1370951)



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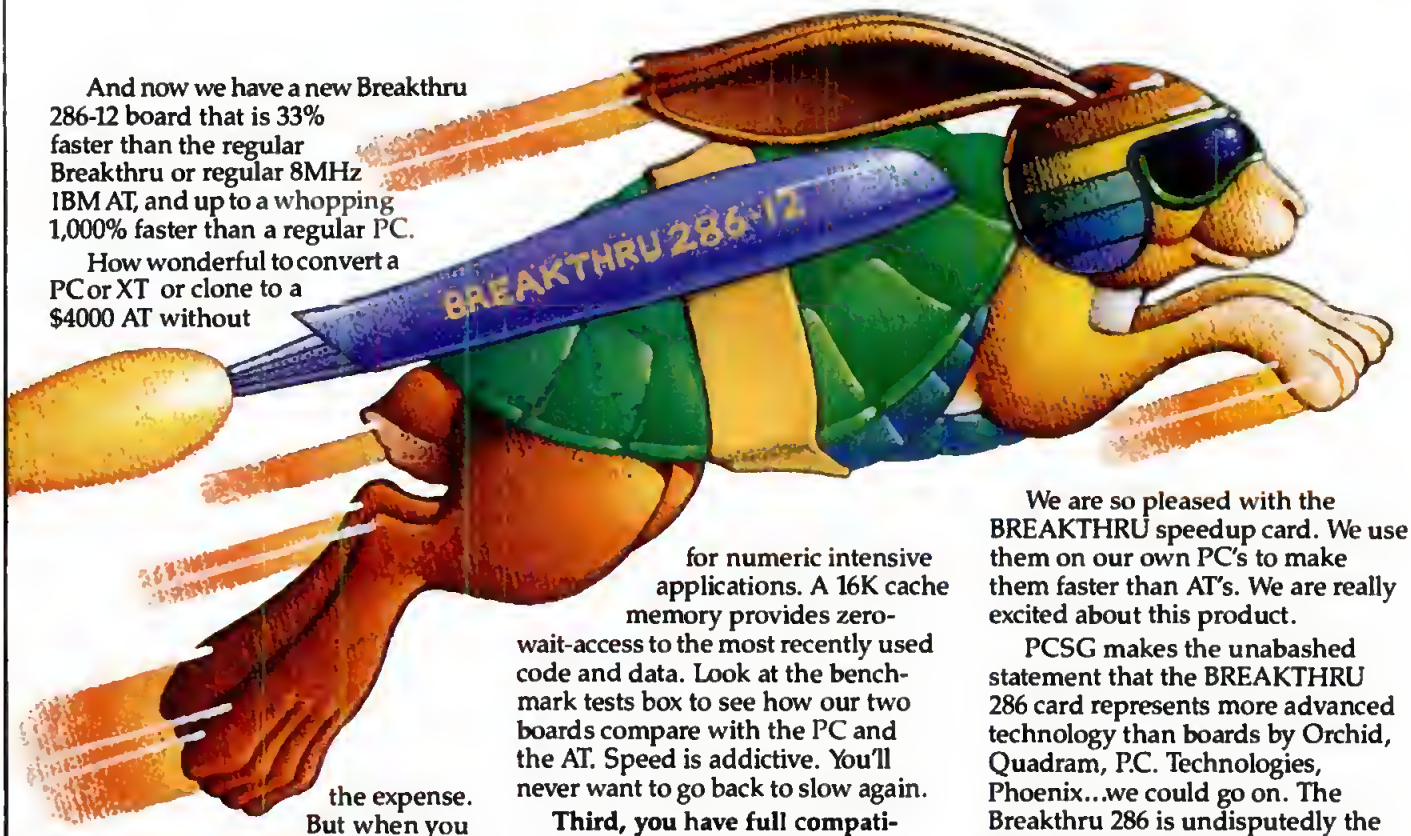
PC 8/87

"...the Breakthru 286 was the card of choice."
PC BusinesSoftwareview (Rated #1)

"The 12-MHz Breakthru 286-12 speedup board is the fastest of those tested, but not the most expensive. On a dollar per-horsepower basis, it could be called the cheapest boost available for an XT."
Mark Welch, InfoWorld (Rated #1)

"The PCSG Breakthru 286 achieved the best performance results of the caching boards tested."
Ted Mirecki, PC Tech Journal (Rated #1)



And now we have a new Breakthru 286-12 board that is 33% faster than the regular Breakthru or regular 8MHz IBM AT, and up to a whopping 1,000% faster than a regular PC.

How wonderful to convert a PC or XT or clone to a $4000 AT without the expense. But when you get ready to spend $395.00 or $595.00 you want to be sure your choice is the very best.

Faster and smarter than an AT-PCSG guarantees it.

HERE'S WHY THESE TWO BOARDS ARE SO SPECIAL.

First, they install so easily. It is a half-slot card, only five inches in length. You don't even have to give up a full slot. What's more, unlike competing products it works in the Compaq Portable and most clones. Easy diagrams show how you just place the card in an open slot, remove the original processor and connect a single cable. There is no software required. From that moment you are running faster than an AT.

Second, it is advanced. The BREAKTHRU 286 replaces the CPU of the PC or XT with an 80286 microprocessor that is faster than the one found in the AT. You have your choice of 8MHz at $395 or 12 MHz at $595. You can plug in an optional 80287 math coprocessor chip for numeric intensive applications. A 16K cache memory provides zero-wait-access to the most recently used code and data. Look at the benchmark tests box to see how our two boards compare with the PC and the AT. Speed is addictive. You'll never want to go back to slow again.

Third, you have full compatibility. All existing system RAM, hardware, and peripheral cards can be used without software modification. Our boards operate with LAN and mainframe communication products and conform to the Lotus/Intel/Microsoft Expanded Memory Specification (EMS). Software compatibility is virtually universal.

Fourth, these are the best. There are several other boards on the market. We at PCSG have compared them all, but there simply is no comparison. What we discovered is that many cards being sold offer only a marginal speedup in spite of their claims and others are just poorly engineered. For example some boards have a cumbersome mechanical switch for going back to 8088 speed, but the Breakthru boards have speed switching software that allows you to drop back to a lower speed on the fly for timing sensitive applications. The 8MHz BREAKTHRU 286 and the 12MHz are unequivocally the best executed and most completely reliable speedup boards manufactured today.

We are so pleased with the BREAKTHRU speedup card. We use them on our own PC's to make them faster than AT's. We are really excited about this product.

PCSG makes the unabashed statement that the BREAKTHRU 286 card represents more advanced technology than boards by Orchid, Quadram, P.C. Technologies, Phoenix...we could go on. The Breakthru 286 is undisputedly the fastest turbo board with the biggest bang for the buck. And we include FREE the $89.95 acclaimed Lightning software, which complements the Breakthru 286 by dramatically speeding up disk operations.

But an ad can't let you experience it for yourself. That's why we sell either BREAKTHRU 286 8MHz or 12MHz on a 60-day trial. If you aren't completely satisfied return it within 60 days for a full refund. Call today with your MasterCard, Visa, American Express or COD instructions and we will ship your card the very next day.

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Breakthru 286

"The Breakthru 286 performed flawlessly with every application we handed it, including copy-protected programs and nine memory-resident utilities at once."
Stephen Manes, PC Magazine

"...Breakthru 286 is a good value and a quality product backed by effective support."
Dan A. Griffin
The Newsletter of the AutoCAD User's Group

Make Your IBM PC Faster Than an AT in Just 5 Minutes!

Accelerator Cards: Speed and Value

Speed figures are consolidated results from 10 tests of CPU performance (See Accelerator Boards Special Report, December 1, 1986.)

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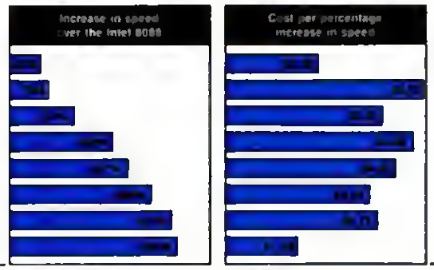
☐ Univation Dream Board	$512
☐ Orchid Turbo EGA	$945
☐ ST&D Standard 286	$995
☐ Classic Speedpack	$995
☐ Orchid PC-Turbo 286e	$1,195
☐ Breakthru 286-12	$595



REPRINTED FROM INFOWORLD, APRIL 27, 1987

Breakthru 286-8MHz-$395
Breakthru 286-12MHz-$595

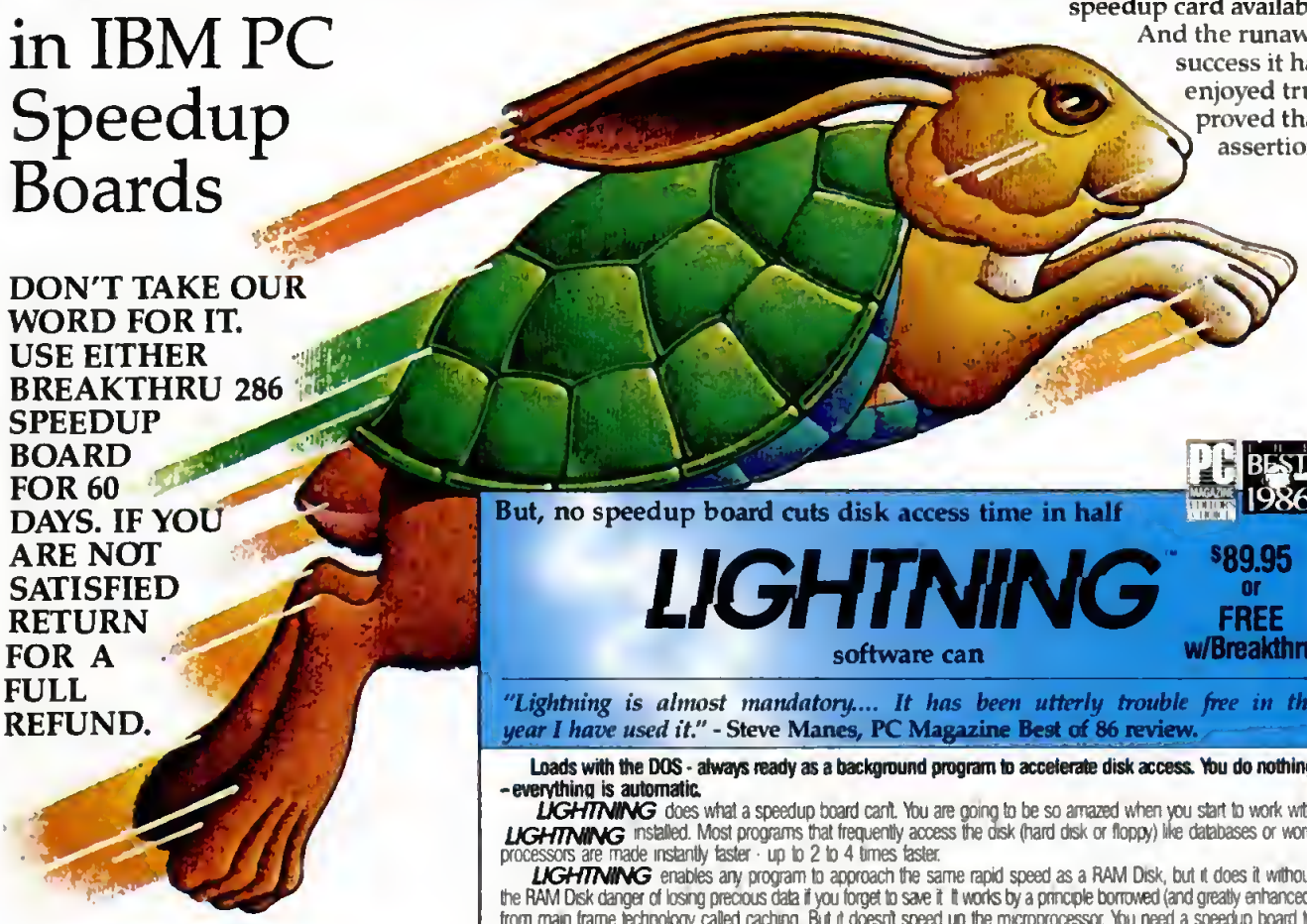
LIGHTNING™—FREE with Breakthru speedup hardware—$89.95 purchased separately

We are excited about our three speedup products. You probably know about our Lightning disk access speedup software that was awarded PC magazines's Best of 1986 award (see box). After the smashing success of Lightning, we developed the Breakthru 286 board to be literally the most advanced, fastest, most feature-rich board available. Now we go ourselves one better with the Breakthru 286-12. This new board has the clock speed cranked up from 8 to 12 MHz for speeds up to 10.1 times faster than an IBM PC.

From September 1986 we guaranteed that Breakthru was the best designed and most functional speedup card available. And the runaway success it has enjoyed truly proved that assertion.

The Next Generation in IBM PC Speedup Boards

DON'T TAKE OUR WORD FOR IT. USE EITHER BREAKTHRU 286 SPEEDUP BOARD FOR 60 DAYS. IF YOU ARE NOT SATISFIED RETURN FOR A FULL REFUND.



PC MAGAZINE BEST 1986

But, no speedup board cuts disk access time in half

LIGHTNING™

software can

$89.95 or FREE w/Breakthru

"Lightning is almost mandatory.... It has been utterly trouble free in the year I have used it." - Steve Manes, PC Magazine Best of 86 review.

Loads with the DOS - always ready as a background program to accelerate disk access. You do nothing - everything is automatic.

LIGHTNING does what a speedup board can't. You are going to be so amazed when you start to work with *LIGHTNING* installed. Most programs that frequently access the disk (hard disk or floppy) like databases or word processors are made instantly faster - up to 2 to 4 times faster.

LIGHTNING enables any program to approach the same rapid speed as a RAM Disk, but it does it without the RAM Disk danger of losing precious data if you forget to save it. It works by a principle borrowed (and greatly enhanced) from main frame technology called caching. But it doesn't speed up the microprocessor. You need a speedup board to improve operational speed.

LIGHTNING is the standard against which all our competition measures itself because we achieve universal compatibility with other software and with complete reliability. Data is never lost. *LIGHTNING* fully exploits Above Board memory.

Order *LIGHTNING* separately or get it free with your Breakthru 286 board.

"...the Breakthru 286 was the card of choice."
PC BusinesSoftwareview (Rated #1)

"The 12-MHz Breakthru 286-12 speedup board is the fastest of those tested, but not the most expensive. On a dollar per-horsepower basis, it could be called the cheapest boost available for an XT."
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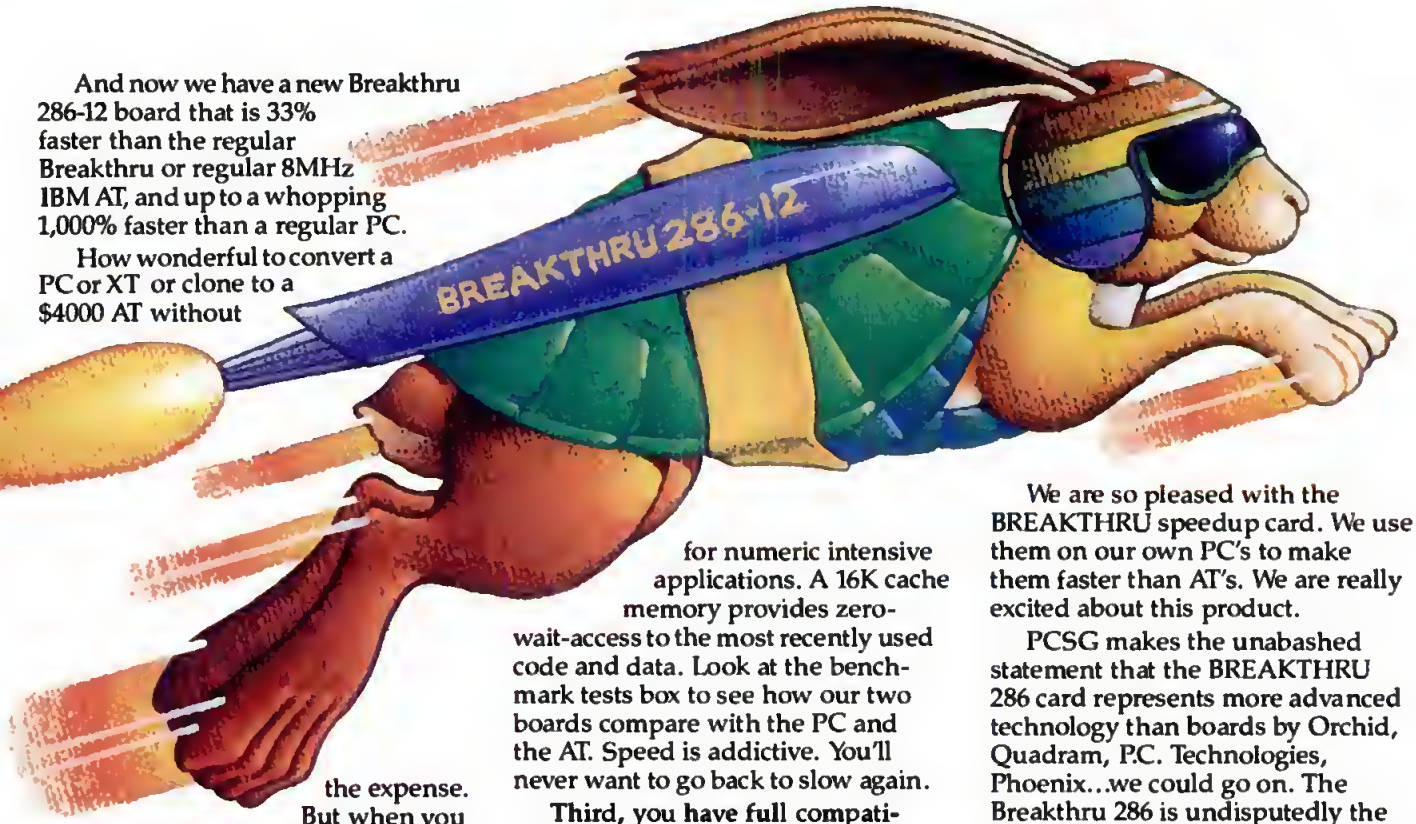

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■ STEPHEN MANES

THE LAPTOP TAPES

The U.S. decision to slap a tariff on laptops mystified many observers. Why were laptops singled out? Our investigators have uncovered the logic behind that decision.

Our special prosecutor in the Laptopgate Affair discovers a secret tape cassette in the leatherette carrying case of a well-known Japanese make of portable computers.

TRADE ADVISER: Gentlemen, we have a problem.

DIPLOMATIC ADVISER: You're not just whistlin' [expletive deleted] "Dixie."

CEO: Well, let's look at the picture.

ASSISTANT TRADE ADVISER: Sir, as you know, we need to take decisive action against the Japanese for dumping electronics parts here and closing their gates to our exports. These dangerous practices have made substantial inroads into American industry. Something clearly must be done.

DIPLOMATIC ADVISER: As Felix the Cat would say, "Righty-[expletive deleted]-o!" But what? That is the question.

ASSISTANT TRADE ADVISER: Yes, sir. Our current strategy suggests punitive tariffs levied against a variety of products. Option 1—the "strong" option—is to levy a heavy duty across the board on Japanese computer chips.

MILITARY ADVISER: No can do. Those chips are in darn near everything we use. Eliminate them, and you've just eliminated our national defense.

ASSISTANT TRADE ADVISER: Option 2: VCRs.

ECONOMIC ADVISER: Won't wash. VCRs are essential to the liberty and lifestyle we cherish. For example, many investors are gaining new insights from the advice in my well-received "Stocks-on-Tape" course. Perhaps you saw the review in *The Wall Street Journal*.

ASSISTANT TRADE ADVISER: CD players?

PRESS SECRETARY: Won't cut it with Congress. All the assistants have them in their offices. I hear howls.

ASSISTANT TRADE ADVISER: TV sets?

ECONOMIC ADVISER: Not the big-screen ones. Too much fun at parties.

DIPLOMATIC ADVISER: And not the little tiny ones. How else can you keep up with baseball when you're on the road?

CEO: How about those—what did we used to call 'em when I was in the business— 19-inchers? I bet nobody buys those anymore except maybe poor folks.

DIPLOMATIC ADVISER: [Expletive deleted] splendid idea, sir.

PRESS SECRETARY: OK by me.

ASSISTANT TRADE ADVISER: Fine. Now that we've attacked the consumer electronics field, perhaps we should tackle computer technology again. Printers?

MILITARY ADVISER: Negative. It'd end up costing us too much to produce all our sextuplicate forms.

ASSISTANT TRADE ADVISER: Desktop computers?

TRADE ADVISER: Korea and Taiwan aren't on today's agenda.

ASSISTANT TRADE ADVISER [*Hesitantly*]: Laptop computers?

CEO: Did you say "claptrap" computers?

ASSISTANT TRADE ADVISER: Laptop. You know, something that fits on your lap.

CEO: I get it. Like a TV tray. You mean to tell me they make a computer that tiny?

ASSISTANT TRADE ADVISER: Yes, they do, sir.

CEO: That's amazing. American technology is the best in the world.

TRADE ADVISER: It certainly is, sir. But, you see, most of these laptop machines rely on *foreign* technology.

[*19 minutes of blank tape.*]

CEO: Oh. Well, I thought you said "claptrap" computers. We've certainly got a few of those around here.

[*General laughter.*]

ASSISTANT TRADE ADVISER [*Chuckling sincerely*]: That's rich, sir.

PRESS SECRETARY: The FCC was considering an outright ban on laptops.

TRADE ADVISER: Interference with the airwaves, was it?

MILITARY ADVISER: Couldn't be. The $10,000 laptops we use don't rely on batteries and are totally impervious to radiation. I believe the boys call 'em slide rules.

PRESS SECRETARY: No, the FCC feels the machines can be used to create offen-

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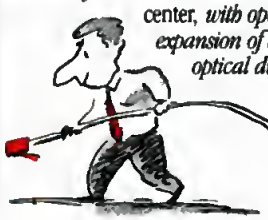

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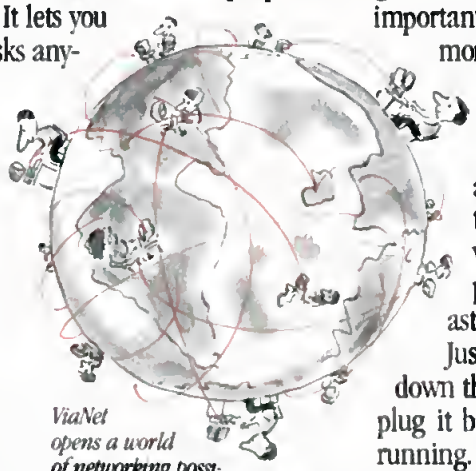

ViaNet opens a world of networking possibilities, and an endless variety of configurations to match your work style.

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When you're shopping for a network, when you're looking for a way to boost productivity and efficiency, when you're desperate for an approach that makes your investment in PCs pay off, there's just one word to remember: ViaNet.

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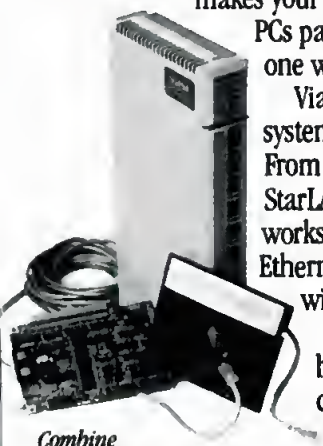

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That's where ViaNet really shines.

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■ **STEPHEN MANES**

sive language and left where children can see them.

ESPIONAGE ADVISER: Gee, those laptop machines sure make *our* lives easier. We can always keep track of their users, since sooner or later they have to plug in their modems and use the phone lines.

TRADE ADVISER: Where are you, buddy? Back in the days of the TRS Model 100s? Today's laptop users are independent individualists with rugged 3½-inch DASDs. [*Transcriber's note: Direct access storage devices. As a civilian, the trade adviser was an executive with a major computer firm.*]

CEO: What? Did you say . . .

TRADE ADVISER: No, sir.

CEO: Well, see that you don't.

TRADE ADVISER: Yes, sir. As I was saying, laptops can hold a huge amount of data in a box the size of a briefcase.

ESPIONAGE ADVISER: No kidding? We'd better look into that.

MEDICAL ADVISER: Don't forget the safety and welfare angles. Our preliminary studies suggest that using these laptops can be hazardous to health.

ECONOMIC ADVISER: On the other hand, we must factor in the productivity gains of extended work hours.

TRADE ADVISER: True. I personally know one sharp fellow who says that with all these meetings to attend, he has to get all his work done at home on the laptop.

ASSISTANT TRADE ADVISER: [*Coughs.*]

SPIRITUAL ADVISER: Let's not forget that these things pose a considerable threat to the traditional values we hold dear.

CEO: Huh? Upsetting traditional values?

SPIRITUAL ADVISER: Laptop computers discourage family interaction. When there's a computer on your lap, there's no room for a child or a spouse. And these insidious devices are rarely hooked up to mainframes; they discourage the kind of team playing that makes America great.

MEDICAL ADVISER: I concur. And, as I mentioned before, we have preliminary studies of the dangers of abuse of those tiny LCD screens.

ASSISTANT TRADE ADVISER: [*Gasps.*]

DIPLOMATIC ADVISER: Uh-oh. What [expletive deleted] can happen?

MEDICAL AND SPIRITUAL ADVISERS [*Simultaneously*]: You can go blind.

[*There is a stunned silence.*]

TRADE ADVISER: Increased tariffs on laptop computers?

[*There is a flurry of "ayes."*]

CEO: Gentlemen, this is yet another salvo in a—gee, something-or-other, you know—for the American way of life. Well, that old Seiko watch is beeping away. Time for my ginseng. . . .

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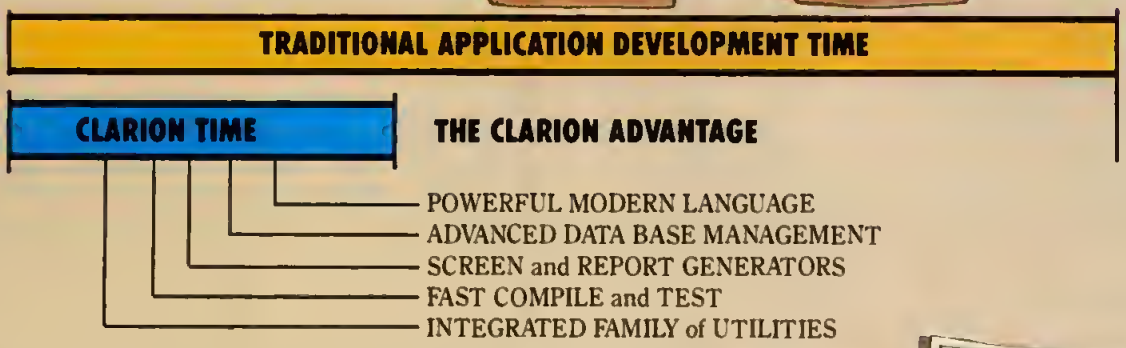

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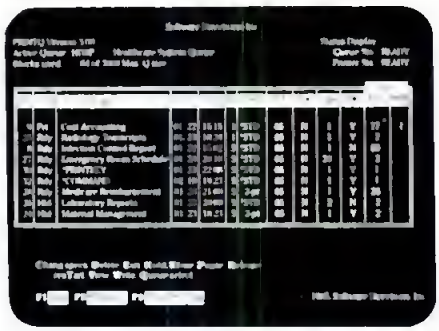

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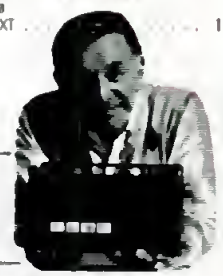

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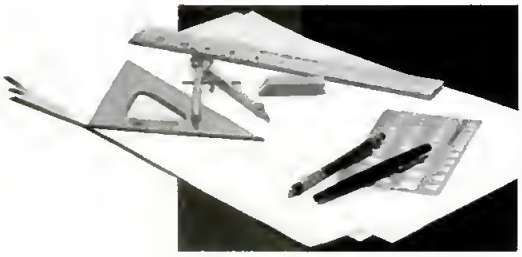

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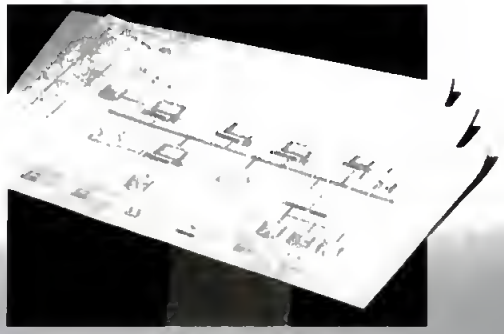

CIRCLE 164 ON READER SERVICE CARD

SUPPLEMENTING THE KEYBOARD:

POINT-AND-SHOOT DEVICES

Alternate input is no Mickey Mouse world. While only a tenth of all PCs have mice or pointing devices attached now, the growth of graphics-based software augurs a bright future for them. Here's a look at some reasons to get away from your keyboard.

The world of alternate input devices seems to attract more than its share of eccentric gizmos crusading to tear you away from the QWERTY keyboard and the Microsoft Mouse. Some of them offer true alternatives, others a good belly laugh.

Take, for instance, the Maltron keyboard. Please. Its inventor no doubt considers it a milestone. Millstone would be more like it. The concept behind the Maltron keyboard, roughly put, is to sever the left and right halves of a keyboard, reassemble them with the numeric/cursor pad in between, and below that place a pair of eight miscellaneous-key arrays *angled* up and out, much like Dr. Spock's eyebrows. The half-dozen key clumps are at several heights. Some are slightly dished. The whole affair appears to have cured under a heat lamp. And of course there's a toggle to switch you between Maltron *Qwerty* and Dvorak key layouts.

Then there's the Versatron Foot mouse. Why reach for a Ctrl- or Alt-key combination when you can tap a foot mouse instead?

The most talked about non-mainstream alternate input device is the Dvorak keyboard, meant to be a speedier alternative to the QWERTY keyboard. QWERTY's background lore is well known: designed in the 1800s, it spreads out the most commonly used keys over all three alphabetical rows, supposedly because manual typewriter mechanisms couldn't keep up with fast typists. Whether by indifference or by some unseen conspiracy, the Dvorak keyboard never caught on. Incidentally, the Dvorak keyboard is unrelated to *PC Magazine*'s John Dvorak, although our Dvorak is part crazy, too.

Dvorak fans believe American business wastes thousands of hours every day typ-

ing 10, 25, or 50 percent less efficiently than possible. No doubt some Dvorak fans also believe that the same sinister hand that supposedly suppressed the 200-mile-per-gallon Pogue carburetor (allegedly Big Oil and Detroit in cahoots) keeps Dvorak keyboards off your desks. Reality is somewhat duller: the energy in a gallon of gas couldn't move 3,500 pounds 200 miles even at 100 percent engine efficiency, and carefully done time-and-motion studies show only fractional gains for a Dvorak keyboard. Are you willing to switch for a 3-percent speed gain? And what about the time spent on the relearning curve? But if you want to try, any keyboard enhancer like *SuperKey* or *ProKey* can remap your keyboard. Keep us posted on the results.

Besides, the market has already spoken. The Maltron keyboard and the Versatron Footmouse are no longer being produced, and no Dvorak keyboard maker has yet retired to Tahiti.

LET'S BE SERIOUS In this issue, *PC Magazine* examines the mainstream of alternate input devices: mice, light pens, touch-screens, tablets and pads, trackballs, and keyboards incorporating trackballs or touch pads that help you point, select, encircle, define, expand or contract text or graphics.

We passed on the Maltron keyboard and the Footmouse. We also passed on joysticks. Their main attribute—an automatic return to center when you relax your grip—doesn't answer many pressing needs in business software, unless your business relies on *Flight Simulator*.

In future issues, we'll look at alternate input devices of different sorts: voice recognition devices, bar code readers, plus optical character recognition (OCR) and graphics scanners.

MOUSE POWER While *PC Magazine* reviews every mainstream category of alternate input device in this cover story, the one that most people will buy is a mouse—most likely a Microsoft mouse.

Compared with other alternate input devices, mice are best for pointing at and picking objects on the screen or for surrounding and defining groups, such as selecting several adjacent objects in a drawing, or parts of two sentences in a document. Anyone who's used *Microsoft Word* or *Windows Write* (essentially barebones *Word* that comes with *Windows*) quickly becomes fond of the ease of selecting sentences, whole paragraphs, or fragments, including the spaces before or after a sentence. But mice aren't very good for drawing or signing. A stylus or penlike device does that best.

The Maltron keyboard was an eccentrically designed gizmo that never quite caught on.

The Versatron Footmouse gives you a hand by letting you tap PC commands with your feet.

Trackballs function much like mice turned upside down, although compared with mice, they're clumsy at click-and-drag operations. Just don't say that within earshot of Honeywell, the defender of the trackball faith.

Touch-pads and touch-screens don't show you where you are on the screen until you make the touch. Touch-screens do work well in general (non-PC) applications—bank teller machines, airport information displays—because it's natural to point to the selection you want on screen. However, if you put one on a PC, keep a bottle of Windex handy, especially if your monitor faces the window. The shiny screen constantly tells you if your tie is straight. *PC Magazine* reviewers also found that their arms grew tired through repeated lift-and-point operations; lower the screen to rest your arm, and your neck grows stiff.

Light pens, which track when the electron beam illuminates a given pixel on-screen, have many of the same benefits and drawbacks of touch-screens. Some users grow accustomed to the drag of the cord or the weight of the battery-powered cordless units. Others never do.

Tablets and pads are best with applications that have dozens of choices, especially CAD or, more recently, desktop publishing. Rather than select an on-screen menu and then pick an item off that, you go right to the item on the tablet. For instance, in *PageMaker*, to select 12-point Times Roman, you'd pick the Text windowshade, select the Text option, then Times Roman, then 12 point, then click OK. With the tablet, you go right to 12-point Times Roman and press once. Tablets also can serve as mouselike pads, either with mice or pucks, which are mouselike devices that have more friction.

Those who want the benefits of a mouse or tablet but lack desktop space may want to look into keyboards that have both. Key Tronic Corp., the well-known replacement keyboard manufacturer, offers a keyboard that has what looks like a touch-pad located on the board to the right of the keys. What's even neater, the touch-pad emulates cursor keys, a mouse, a graphics pad, and even has a function-key mode.

And if you're in a hostile environment—say, a factory floor—a membrane keyboard is the only type likely to survive more than a week or two. (You seal the rest of the PC in a special case and filter the air supply going through the fan, or buy a special ruggedized PC.)

In the reviews that follow, *PC Magazine* presents a roundup of mice, light pens, touch-screens, tablets and pads, trackballs, and special keyboards. As *Windows* and graphics-based software grow more popular, pointing devices will become an essential part of your PC, not just a curiosity next to the keyboard.

Bill Howard is an executive editor on the staff of PC Magazine.

Photographs: Roberto Brosan

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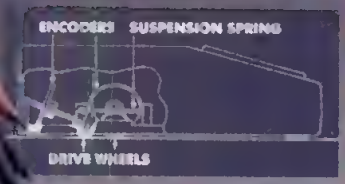

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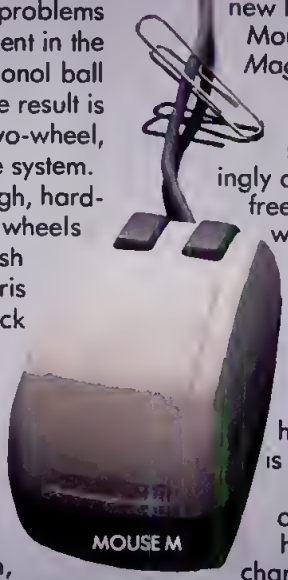

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KEYBOARDS
BEYOND THE ORDINARY

Although a revolutionary new keyboard is not likely to overtake the standard IBM-style keyboards, certain computer environments and individual user needs demand specialized keyboards. To capture the market for specialized keyboards, vendors are offering keyboards without keys—membrane keyboards—and keyboards that incorporate other input devices—trackballs and touch-pads.

MEMBRANE KEYBOARDS Remember the Sinclair Z80 computer kits—those tiny computers that cost less than $100 and actually worked? The keyboard (to use the term loosely) was a tiny panel of membrane keys, and while it was hard to know if you had pressed a key, at least you didn't have to worry about spills gumming up the works.

When computers first came out, people discovered that the machines did not fare well when their keyboards were bathed in coffee and other typical workplace hazards. Some work settings—such as factories, where a stock PC cannot possibly survive—have even tougher environments than that found on an office desktop. Membrane keyboards are a response to at least one part of the problem.

Membrane keyboards lack keys. They're covered with a touch-sensitive, seamless material. To use them, you simply press different keyboard areas, sometimes called *buttons* or *blisters*, that represent keys. You get a little tactile feedback from the "keystroke" since the buttons are slightly domed bumps that give with a small snap when you make contact.

The price you pay for a wipe-clean keyboard is that it takes considerable pressure to execute each keystroke—about a 15-ounce force according to the specification

Getting your message across to a computer may demand a specialized keyboard. The current crop of keyboard varieties includes a keyless, membrane keyboard, plus hybrids offering a touch-pad or trackball in addition to keys.

sheet. So you'll want to reserve a membrane keyboard for situations where you'll mostly be doing simple inputting, rather than a lot of touch-typing.

We review here a hardy membrane keyboard designed to withstand a hazardous environment: the Honeywell TCE434-1 XT/AT-Compatible Touch-Panel Keyboard.

BUILT-IN DEVICES A microcomputing wag once described the Macintosh as the computer "for the rest of us who have three hands," referring to its mouse-oriented interface. But some people simply do not want to reach for a separate pointing device when working at the keyboard. Others have enough trouble just organizing their workplace without having to keep premium desk space clear for use as a mouse run.

■ Honeywell's TCE434-1 should survive a wide range of hazards, including plummeting or rocketing temperatures, moisture, sand, and dust.

Yet most people, given the chance, want it all: keys, trackball, mouse, touch-pad—whatever's available. For those who want it all in one place, manufacturers have responded by building a pointing device like a trackball or a touch-pad into their replacement keyboards for PCs.

We looked at two of these hybrid keyboards: the Key Tronic KB5153, which incorporates a 3½-inch touch-pad along with AT-type keys, and the WICO Smartboard, a programmable keyboard that has a built-in ball designed to substitute for a trackball. True to the spirit of specialized keyboards, both these products are highly flexible and enable you to customize the way they work to fit your needs.

Membrane keyboards are suitable only in certain environments and applications. And while standard keyboards and input devices—mouse, touch-pad, and trackball—perform better in their original form than combined in a hybrid, the bottom line on keyboards is finding the one that fits your setting, your needs, and your style. Although no one keyboard as yet delivers it all, the mutants reviewed below offer you a choice.

HONEYWELL INFORMATION SYSTEMS INC.

Honeywell TCE434-1 XT/AT-Compatible Touch-Panel Keyboard

The Keyboard Division of Honeywell Information Systems has come up with the PC version of the membrane keyboard: the durable TCE434-1. The $246 touch-panel keyboard is designed primarily for use in hazard-ridden environments, such as factories.

The TCE434-1 keyboard is about the same size and shape as the old AT-style keyboard, but the keys are just bumps marked by embossed lines and printed labels. While it looks like an AT keyboard with membranes instead of keys, its cable is about the same length as the shorter one on the PC and XT keyboards.

HAZARDS The Honeywell Keyboard Division cites a wide range of hazards that the TCE434-1 should be able to survive—many of which most PC users themselves wouldn't tolerate, not to mention their keyboards. These include plummeting or rocketing temperatures (-4 to 149 degrees Farhenheit) and altitudes (-100 to 10,000 feet) as well as shock, moisture, salt spray, sulphur, sand, and dust. Honeywell also makes the claim that the keyboard will tolerate a number of liquids—coffee, cola, and a few that I have not yet found on the average programmer's beverage list: oil, isopropyl alcohol mixed with mineral oil, fluorocarbon cleaning solvent, detergent, and water-soluble cleaning solvent.

PRESSURE You will not be able to touch-type with this keyboard, however, and Honeywell recommends that the TCE434-1 be used in settings that do not require high-speed manual input. I found that I had to watch the screen carefully to see what I had typed, and I had to revert to the Columbus method ("find-it-and-land-on-it").

The TCE434-1 keyboard has its own 8-bit CPU, RAM, and ROM. So if you find its silence disconcerting, you can type in a series of keystrokes to turn on an audible click that the keyboard itself, not the PC's speaker, produces.

In fact, the board is so smart that it knows when it is plugged into a PC, XT, or AT and will configure itself accordingly. There are no DIP switches to set; setup is handled automatically.

I do have two complaints about the keyboard's design: First, while the keyboard has legs that can be opened to tilt it, they can be set to only one position. Moreover, the keyboard tends to slide more easily in the tilted position.

Second, some of the keys, such as the Shift keys, are made up of multiple bumps. So if you press the middle of the Shift key, nothing happens because you are between two bumps. On the other hand, the Spacebar has no bumps and gives no feedback even though it will accept a touch anywhere along its length. This inconsistent response for larger keys makes the keyboard a little harder to learn to use.

For hazardous environments, however, where you do not need to type much information, the TCE434-1 membrane-type keyboard is a useful alternative to the standard PC keyboard.

PC MAGAZINE FACT FILE

Honeywell TCE434-1 XT/AT-Compatible Touch-Panel Keyboard
Honeywell Information Systems Inc.
Honeywell Keyboard Division
4171 N. Mesa, Bldg. D
El Paso, TX 79902
(915) 544-5511
List Price: $246
Requires: IBM PC, XT, AT.
In Short: A rugged membrane-type keyboard that can withstand a harsh environment and simple commands but is not recommended for high-speed, manual input applications.

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KEY TRONIC CORP.

Key Tronic KB5153 Touch-Pad Keyboard

Key Tronic has long been known for its replacement keyboards for the PC. Its KB5153 Touch-Pad Keyboard, priced at $399, is one of its top products, boasting a modified AT-style 101-key layout and a 3½-inch-square touch-pad.

Unlike many touch-pad devices, the KB5153 is versatile. It can operate in four distinct modes: cursor control key, mouse, graphics, and function-key emulation modes. And you can combine the function-key mode with one of the other three modes to add even more customization.

EMULATION MODES The keyboard powers up with the touch-pad in the mode that emulates cursor control keys. When you press the pad and move the stylus in a direction, the cursor moves as if you had pressed the arrow keys for that direction. Where you start to press doesn't matter—the pad registers relative motion. When I tried this mode within *XyWrite III* (known to be cantankerous about keyboards), the KB5153 worked flawlessly. Using the KB5153 for making broad moves was easier than using keystrokes, but I found precise positioning of the cursor for small moves a little difficult at first.

In mouse mode, the cursor moves relative to the motion of the stylus on the pad, in the same way that a mouse works. If you get too close to the edge, you can pick up the stylus and put it down again closer to the center of the pad and keep working.

PC MAGAZINE FACT FILE

Key Tronic KB5153 Touch-Pad Keyboard
Key Tronic Corp.
P.O. Box 14687
Spokane, WA 99214
List Price: $399
Requires: tBM PC, XT, AT.
In Short: A versatile replacement keyboard with a touch-pad that can serve as function keys, cursor keys, a mouse, or a small graphics tablet.

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Key Tronic's KB5153 Touch-Pad Keyboard (left), Honeywell's TCE434-1 Touch-Panel Keyboard (center), and WICO's Smartboard (right) meet needs for specialized or rugged keyboards.

In the graphics mode, the placement of the stylus on the pad corresponds directly to the cursor's position on the screen. This mode is better suited for drawing, although the small pad limits the accuracy compared with larger digitizing pads.

MACROS The function-key mode enables you to assign macro strings to different sections of the pad. Here the keyboard works like popular keyboard macro programs. You assign a series of keystrokes to a key; if you want to change them later, you can edit the strokes with the editing program, which is straightforward and fairly easy to use. The distribution disk includes a number of predefined configuration files to show you how these are set up. Also, the keyboard comes with function-key-mode files for DOS, *1-2-3*, and *WordStar*, and includes small templates for each of these programs that fit on the pad to mark the location of the function keys.

Since you can assign varying numbers of function keys, you can configure the keypad for a 2 by 2, 3 by 3, 5 by 5, or 6 by 6 matrix of function-key locations. The KB5153 comes with pads of grid paper in all four sizes so that you can label your choices. I set up a 3 by 3 set of function keys for *XyWrite* and found that they worked perfectly and quickly. You can combine the function-key mode with one of the other modes to enable the emulation of function keys as well as cursor key, graphics, or mouse emulation.

OTHER ATTRACTIVE FEATURES If the CapsLock and NumLock indicator lights go out of sync, you can issue a set of keyboard commands to set them straight. The KB5153 also has a Pause key and a Reset key; the first pauses a scrolling display, and the second works with the Ctrl key to initiate a warm reboot.

The keyboard makes a quiet click that you can turn off easily if you prefer. The documentation that comes with the keyboard is clear and well organized.

I have two reservations about the KB5153. The first is subjective: I find the touch a little soft and slightly "mushy"—a sharp contrast to the original PC keyboard. The second concerns the way you set the product up for use on an AT. You must first remove a sticker from

Photograph: Roberto Brosan

the back and then reach in with a pair of tweezers or needle-nosed pliers to remove a small jumper located deep within the keyboard. Getting it out isn't a big deal, but keeping track of the small part and replacing it later when using the keyboard with a non-AT machine might be. A small switch would probably add slightly to the cost of the KB5153, but it would be much easier to work with.

Overall, I found a great deal to like about the KB5153. It takes up little more space on my desk than the keyboard it would replace, and it offers a wide range of functionality. Its function-key mode alone would be enough to justify its use for me, since I can never remember all my Alt-key macro assignments. The mouse, graphics, and cursor control modes are welcome extras.

WICO CORP.

Smartboard

The Smartboard, from WICO Corp., is designed for people who don't want to give up any of their valuable desk space to a mouse or other input device yet still want one available. At first glance it appears to be the perfect solution: a trackball mounted in a keyboard. But the Smartboard, which WICO lists at $399.95, is not what it appears to be.

The Smartboard has some interesting features. It has three separate programmable units: the standard keyboard, the function keys, and the ball. The indicator lights, labeled Standard Keyboard, User Functions, Smartball A/B, and the enigmatic Low Battery, are a hint of what it can offer. Besides the familiar keycaps (laid out in a pattern unlike that of any IBM keyboard), you also find Prgm (for Program), Mode Select, Reset, and Basic. On the board's right side is the beige ball, waiting to be rolled.

THE KEYBOARD The standard keyboard unit comes configured in QWERTY format. By using the appropriate keys, you can quickly change it to the preprogrammed Dvorak layout, or you can swap key positions at will.

Similarly, the function keys come with the standard DOS assignments, but you can easily program them to produce various character strings that execute commands.

To keep the programming intact when the computer is turned off, the keyboard uses three penlight batteries. An indicator light warns when the power is low. You do not need batteries to operate the keyboard, though.

The keyboard has an aid for BASIC programmers: when you press the Basic key, all the letters come out in capitals; when shifted, they produce 26 different BASIC commands. And if you can't give up the standard PC keyboard, the Smartboard even offers you the opportunity to daisy-chain it (through a connector on the Smartboard's back) to use along with the Smartboard when you want to.

The Smartboard's soft touch is slightly stiffer than that of most clone keyboards; it gives you a little tactile feedback. You can turn the internal keyclick on and off through an easily accessed set of DIP switches.

The keyboard performed fairly well in use, although the Enter key occasionally did not register or registered twice. Typing quickly is fairly easy on the Smartboard.

THE BALL The Smartboard's ball appears to be a mouse-emulating trackball. In operation, it is merely a sophisticated function key/cursor key option, lacking the range of movement that a trackball or a mouse can offer.

The ball comes preprogrammed to emulate the cursor keys, but you can easily program it to produce other keystrokes, as with macros. The ball's limits are quite clear when it's in the cursor-key-emulation mode. Unlike a mouse or a trackball, however, the ball will generate only two types of movement when it is emulating the cursor keys. You can program it either to produce one of four responses (up, down, left, and right) or to produce one of eight responses (up, down, left, and right, plus the diagonals: up left, up right, down left, and down right).

■ The Smartboard's ball appears to be a mouse-emulating trackball. It's really just a sophisticated function/cursor key, lacking the range of movement of a trackball.

Although it's certainly not the equivalent of a true trackball, the Smartboard's ball does move the cursor accurately, within its limits. It even operates without a hitch within *XyWrite*. Unfortunately, the Smartboard does not come with a mouse emulation driver, and you cannot use it with mouse-driven software (except, of course, when the software will accept alternative keyboard commands).

While the Smartboard is not an adequate replacement for a mouse or a trackball, it does have some interesting and unique features. For example, while it is designed to hook up to either a PC or an XT (it is not AT compatible), you can get an adapter to attach it to an Apple II, II+, or IIe.

WICO's Smartboard has strong appeal for BASIC programmers and those wishing to experiment with the Dvorak layout. But its ball feature is of limited value. If you're looking for a viable alternative to a mouse for your favorite drawing or *Windows* application, you'll want a true trackball. PC

Alfred Poor is a contributing editor of PC Magazine.

PC MAGAZINE FACT FILE

Smartboard
WICO Corp.
6400 West Gross Point Rd.
Niles, IL 60648
(312) 647-7500
List Price: $399.95
Requires: IBM PC or XT.
In Short: A programmable keyboard that has lots of features and a good feel, but the built-in ball is not the mouse substitute that it might appear to be.

CIRCLE 647 ON READER SERVICE CARD

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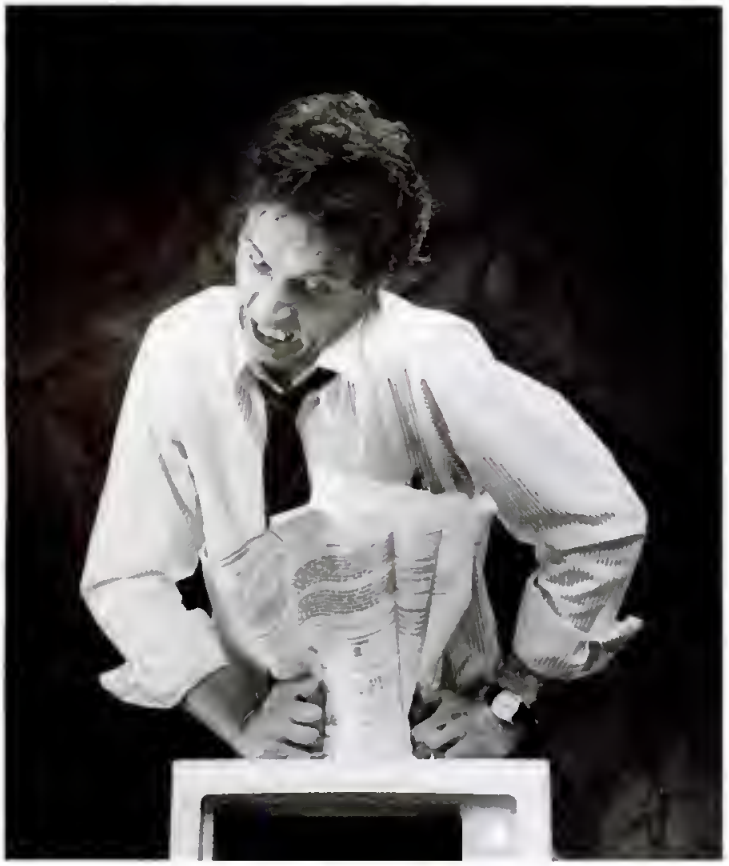

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Catch the page!

CIRCLE 148 ON READER SERVICE CARD

LIGHT PENS FOR ON-SCREEN DRAWING

As drawing or point-and-shoot devices, light pens might seem as natural as pen and ink. But limited software drivers and ergonomic drawbacks restrict their use.

Light pens are jacks of two trades. You can use them like touch-screens, with point-and-shoot menus; you can use them like drawing tablets, mice, or trackballs for drawing.

You're most likely to encounter light pens in applications such as order entry in warehouses or point-of-sale displays. You'll also find them in graphics and CAD/CAM applications.

All light pens work exactly the same way. To illuminate the screen, your monitor fires an electron beam at the phosphor-coated back of the screen at intervals of 1/60 second. When this electron beam hits any point on the screen, the screen's phosphors become "excited" or glow.

The electron beam starts at the upper-left-hand corner of the screen and travels left to right down the face until it reaches the lower-right-hand corner when the process starts again. The light pen uses a lens that senses the glowing state of the phosphors. It determines the *x-y* screen coordinates of the detected area by measuring the time it takes for the electron beam to reach the pen. The pen passes its information back to the computer through the color/graphics adapter, and software determines what happens next.

Light pens share a number of similarities. All plug directly onto any standard color/graphics adapter, making them easy to install; all are shaped and weigh about the same.

Because of their similar operation, any software package that supports one light pen will be able to drive products from all manufacturers. Light Pens that operate with drivers designed especially for them, such as the ones Microsoft supplies for the FT-156, will run better under those drivers, however. Any package that runs under *Microsoft Windows*, such as *PC-Draw* and

*In*a*Vision*, can use a light pen.

You should be aware that the light pens themselves come with few, if any, software drivers. The Warp Speed Light Pen comes with a driver for Lotus's *1-2-3* and provides an optional interface for *AutoCAD*. That's it. No other light pen tested comes with any other drivers.

You can, if you wish, program in BASIC any of the light pens reviewed here. And all of the pens' manuals describe how to use that language to control the cursor with a pen.

ERGONOMIC DRAWBACKS Light pens are similar to, and perhaps worse than, touch-screens (also reviewed in this issue) in terms of their less-than-optimal ergonomic design. Just as you do with a touch-screen, you must lift your arm to point to a screen that is perched in the usual position atop your CPU. Unlike touch-screens, pens not only make you work against gravity, they make you wrangle with a coiled cord bent on dragging your pen down. The Feather Cordless Light Pen from HEI is, however, a step in the right ergonomic direction.

You can use a light pen either to draw with the cursor or to "click" a menu selection by depressing the tip. Several factors, however, conspire to sabotage these efforts. First, there's a slight gap between your monitor's glass screen and the phosphors beneath, making it difficult to aim the pen, particularly when you must make a choice from a tightly spaced directory listing. In addition, because of the way the pen reads the light on the screen, you won't obtain a sharp drawing point with the pen. Instead, it will draw and recognize blocky, blobby characters. Finally, the light pen's click is not really a click at all; none of these pens offer any tactile or audible feedback.

If you wish to draw fine lines in a CAD in or sophisticated drawing applications, you can use an optional adapter card that most of these pens offer to increase control of the pen to the pixel level.

Nonetheless, compared with a touch-screen, light pens work with more software and, at a cost of $200 or less, are about one-third the price. They also offer the benefit of allowing you to draw on the screen—albeit for relatively short periods of time. The following product reviews appear alphabetically by vendor name.

FTG DATA SYSTEMS

FT-156 Light Pen

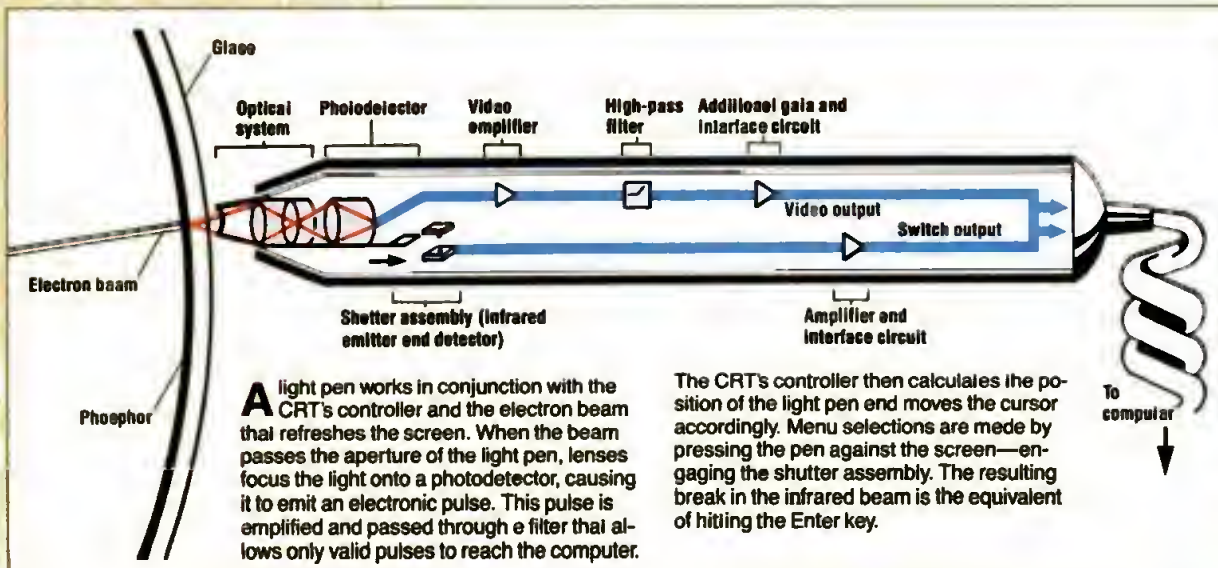
The $195 FT-156 Light Pen, from FTG Data Systems, is designed for systems using color/graphics adapters and CGA monitors. FTG Data Systems also offers its PXL 350 board to boost resolution for EGA applications to the single-pixel level.

The pen comes with an installation kit that includes the necessary cable and jack, an adapter plate for passing the cable out of the computer, a wire tie wrap and tie wrap retainer, a clip for attaching the pen to the side of the computer or monitor (plus an extra in case you lose it), and an antistatic screen wipe.

Installing the FT-156 requires no special expertise. Well-written instructions explain how to plug the cable assembly into a set of pins near the top of the adapter board. You then run the cable through a rectangular plate on the rear panel of the PC, and the included replacement plate has a round hole and a rubber grommet to hold the cable firmly. The tie wrap retainer has a sticky back securing it to the rear panel of the PC to hold any excess cabling.

The other end of the cable has a stan-

How a Light Pen Works



A light pen works in conjunction with the CRT's controller and the electron beam that refreshes the screen. When the beam passes the aperture of the light pen, lenses focus the light onto a photodetector, causing it to emit an electronic pulse. This pulse is amplified and passed through e filter that allows only valid pulses to reach the computer.

The CRT's controller then calculates the position of the light pen and moves the cursor accordingly. Menu selections are made by pressing the pen against the screen—engaging the shutter assembly. The resulting break in the infrared beam is the equivalent of hitting the Enter key.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

FT-156 Light Pen
FTG Data Systems
10801 Dale St., Suite J-2
P.O. Box 615
Stanton, CA 90680
(714) 995-3900
List Price: $195
Requires: IBM CGA or compatible adapter; color monitor or monochrome monitor that does not use a P39 phospho; DOS 1.0 or later.
In Short: The FT-156 is a solid, if average, product. *Windows* offers a special driver for its optional PXL-350 board so you can get resolution down to the pixel level.
CIRCLE 631 ON READER SERVICE CARD

dard phone jack, with a sticky back to attach to the side of your computer. The cable from the light pen has an RJ-11 phone plug that snaps into the jack. This arrangement leaves plenty of room to maneuver the pen without resistance from the cable assembly, ensures that you will not accidentally pull out the connection, and provides a holder for the pen when not in use.

Finally, you install the light pen demo software and boot up. For the most part, the demo software is unremarkable; it includes several games such as Tic-Tac-Toe and Snake, a simple graphics drawing program, and a multiple-choice arithmetic quiz.

The pen comes with a simple calibration program that allows you to make adjustments before you begin and a tool called TEST that verifies the calibration. TEST floods the screen with light, then lets you turn off characters (in text mode) or graphic cells (in high-resolution graphics mode) with the pen. You evaluate the pen's performance by drawing horizontal and vertical lines at different screen intensities.

FTG also provides BASIC, Fortran, and Pascal subroutines and guidance for using assembler and C to write your own software support for the board.

We tested the pen with *Windows* and *PC Draw*, as we did with the other pens reviewed here. A click registers when the pen tip is depressed most of the way down, though there is no audible or tactile feedback. However, the pen made a very annoying metal-on-metal scraping noise on the screen itself when I pressed the pen tip.

Like the other pens, this one had a heavy, coiled cord that pulled down on the back of the pen when I held it up to the screen, making extended use tiring. Its operation was as smooth as any of the others tested.

However, the FT-156 with the PXL-350 board offers a taste of the way that professional light pens should perform. When I used the special driver in *Windows* for the FT-156 board, the light pen was able to get resolution at the single-pixel level, making the drawing line very sharp. However, if you use a standard light pen driver, you will get performance nearer to the norm.

Though plagued by ills common to all light pens, the FT-156 is a solid product. If you use it with the PXL-350 board and with the *Windows* special driver, you'll get an idea of the light pen's potential.

HEI INC.

Fast-Point Light Pen Feather Cordless Light Pen

HEI Inc.'s offerings come in two distinct flavors: the $145 Fast-Point Light Pen and the $195 Feather Cordless Light Pen. While the Fast-Point is a conventional light pen, the Feather is unique: it's cordless. It works by sending its signal to a tiny receiver mounted on top of your monitor rather than through a cable to your display adapter.

Installation for both pens is straightforward. For the Fast-Point, you simply locate the CGA card, then route a connecting cable through the rear of the computer, plug it directly onto the CGA card's light pen port, and attach the plug on the light pen's retractable cord to the junction box. Installation is nearly the same for the Feather pen except that you attach the plug from the receiver to the junction box.

The software for both is the same. Just copy all the files and DOS BASICA onto a work disk. The demo software includes an explanation of the light pen, a calibration routine, Tic-Tac-Toe, and the Graphics Pad program. There's also a limited mechanical drawing tool that lets you sketch

PC MAGAZINE FACT FILE

Fast-Point Light Pen
Feather Cordless Light Pen
HEI Inc.
1495 Steiger Lake Ln.
P.O. Box 5000
Victoria, MN 55386
(612) 443-2500
List Price: Fast-Point, $145; stainless steel barrel model, $195. Feather Cordless, $195.
Requires: IBM CGA or compatible adapter; RGB or composite monitor; DOS 1.0 or later.
In Short: Like many other pens, neither of these comes with drivers. While the Fast-Point is comparable to other light pens tested, the Feather's lack of a cord is a noticeable improvement. However, you can't use the Feather for drawing applications.
CIRCLE 630 ON READER SERVICE CARD

rectangles, diamonds, circles, and lines; fill shapes; add text; remove, change, or replot a shape; save to disk; load from disk; and clear the screen.

Unfortunately, if you're not a programmer, you won't be able to use either light pen with applications that come without light pen drivers. While these demo programs show you what the pens can do, the pens come with no drivers for external applications programs.

However, the manufacturer does supply the source code for the Graphics Pad program. You can examine the code to learn how to write your own subroutines to control the pen.

When we tested the Fast-Point with *Windows*, it worked fine. In operation, the pen's click registered only when the tip was almost completely depressed, and it did not provide any feedback. The heavy coiled cord pulls down on the back of the pen when it is held up, making it tiring to use. However, I found that the pen's brushed aluminum casing provided a good grip. Operation was as smooth as the others tested.

The Feather's lack of a cord was a noticeable improvement. Unfortunately, this pen still has a few bugs that need extermination. The Feather's pen tip only transmits data when pressed. This means that you can't move the cursor on-screen until you click the pen. While this is not a prob-

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CIRCLE 348 ON READER SERVICE CARD

PC MAGAZINE Light Pens: Summary of Features

(Products listed in ascending price order)

	Fast-Point Light Pen	Feather Cordless Light Pen	FT-156 Light Pen	L-PC Lite-Pen	Warp Speed Light Pen
List price	$145.00	$195.00	$195.00	$199.95	$199.99
Graphics adapter	CGA	CGA	CGA, EGA	CGA, EGA, or monochrome	CGA, EGA, or monochrome
Optional adapter card for pixel-level editing	○	○	●	●	●
Power supply	None*	Internal	Internal	None*	None*
Software included	Demo software	Demo software	Pixel support software†	Demo software	Light pen controller software, *Pencad System* (enhancement driver for *AutoCAD*)‡, *Conductor* (driver for *Symphony* and *1-2-3*)‡, *Penmouse* (mouse emulation software)‡

Applications Supported§

	Fast-Point Light Pen	Feather Cordless Light Pen	FT-156 Light Pen	L-PC Lite-Pen	Warp Speed Light Pen
Microsoft Windows	●	●	●	●	●
1-2-3	○#	○#	○#	○#	●
Microsoft Word	○	○	●	○	○
WordStar	○	○	○	○‖	●
WordPerfect	○	○	○	○	○
AutoCAD	●	●	●	○	●
VersaCAD	●	●	○	○	○
PC Paintbrush	●	●	●	●	●
Freelance Plus	●	●	○	○	●
Dr. Halo	●	●	●	●	●
PageMaker	●	●	●	●#	●
Ventura Publisher	○	○	○	○	●

PC—Indicates Editor's Choice. ●—Yes ○—No *Uses PC's power supply. †Software is included with the PXL-350 board. The software includes *MouseTrap*, which is a mouse emulator that provides access to *Microsoft Word* on CGA. Also included are drivers for IBM's *TopView* and *Microsoft Windows*. ‡Optional. §The manufacturers claim that these packages support their light pens. However, if a package has a driver for any light pen, it should support all light pens. ‖Third-party light pen drivers are available for this product. #With *Dr. Halo* or under *Windows*.

lem in applications using a point-and-shoot approach with large blocks, it virtually rules out use of this pen for drawing. Since visual feedback is important to locate every light pen's precise position on the screen, you'll find it difficult to use with point-and-shoot menus if choices are located very close together, as they are in *Windows*. A representative at HEI said that the company is working on a design that transmits continuously, which would make this pen behave like the others.

Another drawback is that the Feather's pen click registers almost as soon as you press it, which could cause it to misfire more frequently than any of the other pens tested. This problem only compounds that caused by the absence of cursor feedback.

The Fast-Point is comparable to the other light pens tested. While the cordless Feather is a wonderful idea, it needs some work to get the bugs ironed out.

■ HEI's Feather Cordless Light Pen is unique: it sends its signal to a tiny receiver on top of your monitor rather than through a cable.

THE LITE-PEN CO.

L-PC Lite-

The $199 L-PC Lite-Pen runs off any CGA light pen port; optionally, you may purchase the Lite-Pen Co.'s Pixel-Plus Adapter Board, which works along with your graphics board to yield a screen resolution of 1,024 by 1,024 pixels.

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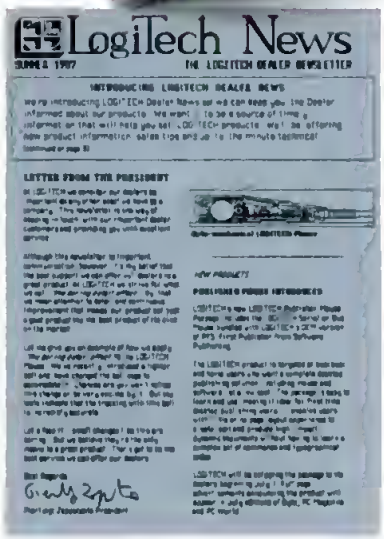
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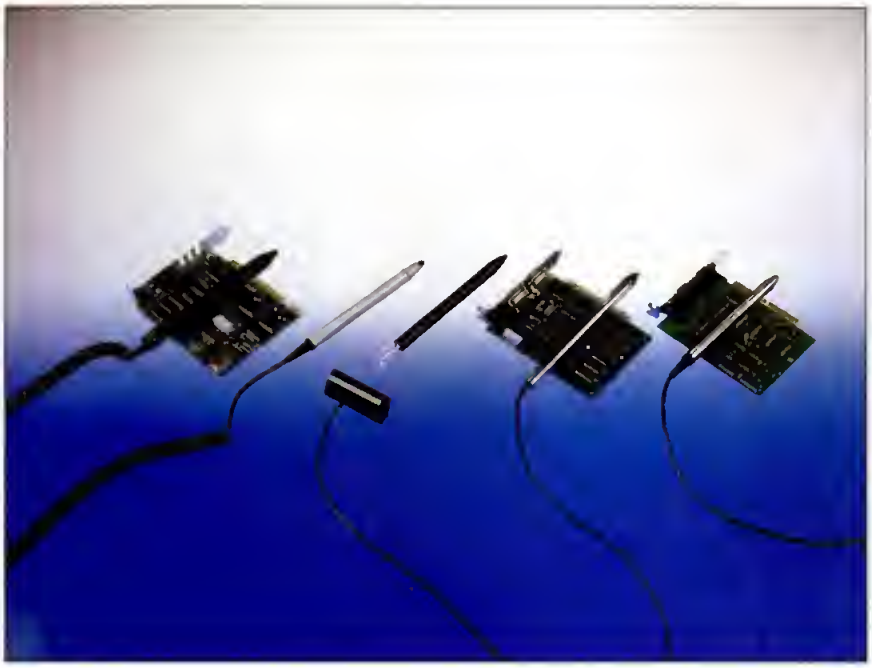

Light pens are effective for both point-and-shoot and drawing applications. Shown here (left to right) are the FT-156 Light Pen, HEI's Fast-Point Light Pen and Feather Cordless Light Pen, the L-PC Lite-Pen, and the Warp Speed Light Pen.

Unless you wish to write your own drivers, however, you'll have little use for the Pixel-Plus board. With the board installed, the pen cannot run on software designed for most light pens, such as the drivers that come with *Windows*. And the board itself comes with drivers only for *Dr. Halo II*.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

L-PC Lite-Pen
The Lite-Pen Co.
12500 Beatrice St.
Los Angeles, CA 90066
(800) 634-1967
(800) 821-7807 (in Calif.)
List Price: $199.95; Pixel-Plus Adapter Board, $159.95.
Requires: Any CGA, EGA, or monochrome adapter; monochrome or color monitor; DOS 1.0 or later.
In Short: A light pen with a large variety of sample programs that will be useful for programmers. Unlike other pens, this one's cord comes with a straight section that reduces the cord's pull on the pen.

CIRCLE 629 ON READER SERVICE CARD

Installing the pen is simple. You remove the computer's casing, route a connecting cable through the rear panel and plug it onto the graphics board, anchor this cable with the included mounting plate, plug the pen into the cable, and set up the software.

You can install the optional half-length Pixel-Plus Adapter Board in any open slot. The manual does a superb job of guiding you through these steps with plenty of detailed illustrations.

Batch files automate the process of setting up the software to drive different systems and to install the Pixel-Plus board. Finally, you must run the simple pen calibration program, whose stored values needn't be changed unless you change your hardware setup. Incidentally, the company sells a special cable for running both a color graphics and monochrome display, so that you may toggle from one to the other.

The demonstration software that comes on the sampler disk is enjoyable and includes educational programs, games, and sample applications. For instance, the Graphics program lets you draw lines, circles, and squares; fill shapes; select colors for foreground and background; choose from two palettes; add text in three sizes; and save and load pictures to and from disk. The Mouseemu program worked well emulating a mouse to drive the *PC Paintbrush* program. In fact, I found that controlling the program with the pen was easier than using the mouse. The sampler disk also contains a driver for the *Dr. Halo II* program from Media Cybernetics. Optional drivers for Lotus's *1-2-3* and for the *Investment Manager* from The Walton Group are also available.

I tested the pen using *Windows* and the light pen driver that bears its name. Operation was as smooth as the other standard light pens reviewed, which is to say not too great. As with the other pens, the cursor position jumps around a bit when the pen isn't moving, but the accuracy of movement is good. L-PC Lite-Pen clicks when the pen tip is depressed almost all the way, with no tactile or audible feedback.

The L-PC's cord is a stroke of genius compared with other light pen cords: it has a straight section of several inches between the pen and the coiling. Because you don't hold up the coiling with the pen, you don't have to fight with it as you use the pen, and it reduces the apparent weight of the pen. Though this may seem trivial, it should reduce fatigue when you use the pen for an extended time.

This pen's demo software makes it fun to use right out of the box and provides good examples for novice and seasoned programmers alike. The cord makes it easier to handle than other pens. But while the L-PC Lite-Pen comes with a board to increase resolution to the pixel level, you'll have to write your own software to make use of that capability.

WARP SPEED COMPUTER PRODUCTS INC.

The $199.99 Warp Speed Light Pen, from Warp Speed Computer Products, comes with a lot of extras. The package includes two separate pens—one for color and one for monochrome displays. The demo program is a combination DOS shell/disk management utility. Better still, the pen comes with three software programs: Pen-

Photograph: Roberto Braun

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PC MAGAZINE EDITOR'S CHOICE

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PC MAGAZINE FACT FILE

Warp Speed Light Pen
Warp Speed Computer Products Inc.
1101 E. Redondo Blvd.
Inglewood, CA 90302
(800) 874-4315
(800) 826-1563 (in Calif.)
List Price: $199.99; Phaser/One card, $99.99.
Requires: IBM CGA, EGA, or Monographics or compatible adapter, IBM VGA, monochrome or color monitor; DOS 1.0 or later (DOS 3.1 or later recommended).
In Short: Warp Speed's light pen comes with a good disk management program and is the only one to include optional drivers for *AutoCAD* and *1-2-3*. However, when you use the drivers, the pen damages data on the screen and leaves garbage characters.

CIRCLE 628 ON READER SERVICE CARD

cad System, an enhancement driver for *AutoCAD;* Conductor, a driver for both *Symphony* and *1-2-3;* and Penmouse, which is mouse emulation software. Finally, I thought, a pen that comes with lots of drivers.

In addition, the optional Phaser One adapter card claimed to bring screen resolution down to the pixel level.

The installation program ran flawlessly. I was able to calibrate the pen and use the included Controller software. (Calibration values are stored and need not be changed again unless you change your hardware setup.)

Controller, the disk management program that comes with the light pen, enables you to use the pen for standard DOS tasks, such as CHDIR, TYPE, COPY, RENAME, DELETE, and so forth. It displays your hard disk's root directory and allows you to move to the other directories to see a list of all files having the extensions .BAT, .BAS, .COM, and .EXE. You can only enter one additional filename extension for the display.

The Controller program also lets you change the pen's cursor (from an asterisk to a cross), print the screen, pause, turn the speaker on or off, enter parameters before executing programs, and even sort files in alphabetical order. This is a great utility program.

The sample software included lets you try out some light pen applications. A simple music program lets you play piano; another lets you play a game of Crazy Eights against the PC. An order entry demonstration lets you select products from a list and choose the quantity from a numeric screen keypad. There's also a pen test drawing program. Unfortunately, not one of these programs gives you more than an understanding of how the pen can be used for the applications.

When we tested the pen in *Windows* with the L-PC Lite-Pen drivers, the response was as smooth as that of the others tested.

Warp Speed's drivers for *1-2-3*, *Symphony*, and *AutoCAD* are shells that you must load before the application. Though such software is much needed for light pens, these drivers behaved poorly, destroying text at the cursor and leaving only garbage characters behind. Nor are these drivers as smooth as those built directly into applications.

In additon, when used with the driver that Warp Speed provides, the pen updates its position only when you click it. This is OK when you have a point-and-shoot application, but it makes the pen virtually useless when continuous selection is called for, such as in a drawing program.

The idea behind the included Penmouse driver was a good one, too: to provide a way to make the light pens look like a mouse to applications that don't support pens. But when I tested the Penmouse emulation using *Microsoft Word*, Version 3.1, configured for Microsoft Mouse, I achieved the same results that I did using Warp Speed's other drivers: garbage on the screen. On occasion, it also hung the system.

Like the Pixel-Plus board that comes as an option to the L-PC Lite-Pen, the Warp Speed's optional Phaser/One card brings resolution to the pixel level. (It also provides a pen port for systems that don't have one.) And as with the L-PC board, there's little in the way of software to run with the Warp Speed board. While it will run with the software that comes with the Warp Speed Light Pen, the board cannot work under *Windows*. Your only other option is to sit down and write your own applications or drivers using the standard light pen routines in BASIC.

The Warp Speed Light Pen is the only package that comes with its own drivers for popular applications that don't come with light pen support. Unfortunately, these drivers were not well behaved. But the disk management program is wonderful and is more useful than any provided by the other light pen vendors. PCM

■ Controller, the disk management program that comes with the Warp Speed Light Pen, enables you to use the pen for standard DOS tasks like TYPE and COPY.

PC MAGAZINE EDITOR'S CHOICE

- **FT-156 Light Pen (paired with the optional FTG PXL-350)**
- **L-PC Lite-Pen**

The relative strengths of different light pens depend on your application. If you're looking for the greatest power, best control, and a Windows driver to support all of the above, your best bet is the FT-156 paired with its optional PXL-350 board.

However, if you don't need such high resolution and do want compatability with standard light pen drivers, the L-PC Lite-Pen is the best choice. It's comfortable to use and comes with a wealth of demo software to help you get started.

Philip F.H. Rose is a project leader on the staff of PC Magazine. *Phil Wiswell is a frequent contributor to* PC Magazine.

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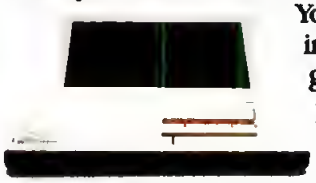

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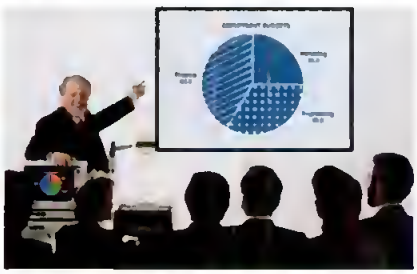

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MICE

FOR MAINSTREAM APPLICATIONS

Once you're done comparing all the input device options, you're probably going to wind up with a mouse. The most common alternate input device, by far, is the mouse. The most common mouse is the Microsoft Mouse, which has more than half the market.

While Mouse Systems was the first company to put mice on PCs, Microsoft legitimized the market with the first Microsoft Mouse in mid-1983 (the one with the Microsoft green buttons) and now holds about half the market—the kind of PC market sector dominance matched or surpassed only by the likes of *1-2-3*, *SideKick*, and *dBASE III*. Mouse Systems and affordable, up-and-coming Logitech (its LogiMouse C7 was *PC Magazine*'s Editor's Choice in a review of five mice in "A Pocketful of Mice," Volume 6 Number 2) are the other market leaders.

IBM is sure to be a factor with its aggressively priced $95 mouse (or "pointing device," as Big Blue stiffly describes it) for the PS/2 line. The IBM mouse plugs into a special round connector socket on the backs of the PS/2 machines. There are two look-alike sockets, one for the keyboard, one for the mouse. On every model north of the the Model 30, they're interchangeable. While the IBM connector looks similar to Microsoft's InPort connector, the two are different.

Microsoft is the first company after IBM to offer a PS/2 connector mouse, adding a PS/2 adapter box to its InPort version. IBM so far hasn't reciprocated and built a version of the IBM mouse for the existing PC/XT/AT line.

Both Microsoft and IBM get their mice from Japan's Alps, but IBM manages to sell its slightly stiffer-buttoned variant for half the $175 to $195 Microsoft charges.

Right now, estimates of mouse popu-

On 8 to 10 percent of all PCs, mice are by far the most common alternate input device. You can use them with many mainstream programs. And if desktop publishing, CAD, paint, or drawing programs are in your future, a mouse is certain to follow.

larity run around 8 to 10 percent of the installed base of 10 million PCs, according to Microsoft. (Figure in every other pointing device ever connected to a PC, and input device penetration rises to, oh, about 8½ to 10½ percent.) Compare that to the Mac's 100 percent penetration. The reason: only about 250 of the roughly 10,000 (some say 20,000) MS-DOS programs available really need a mouse or other alternate input device. The old-guard view was expressed by MicroPro's Seymour Rubenstein, who opined that mice would be valuable around the time people grew third hands. Like many other slogans, it made more sense as a slogan than as rational thought, ranking right up there with the radical feminist bumper sticker, "A woman without a man is like a fish without a bicycle."

■ The Microsoft-IBM market dominance means that three-button mice, even if they are a better idea, may never evolve as the dominant mice.

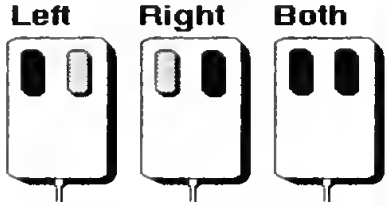
Still, of today's very *top*-selling programs, only *Microsoft Word* really needs a mouse or other pointing device. *Word*'s ability to select, cut, paste, duplicate, or otherwise modify the marked block text is breathtakingly fast compared with the Rubenstein method of marking a block-begin, cursoring to the end, then marking a block-end.

The pace is quickening, though. For instance, the next version of *1-2-3* is expected to have mouse support built in. Microsoft's *Excel*, due later this summer or early fall, will use a mouse.

Microsoft Windows and the programs running under *Windows* are crippled without a mouse. If desktop publishing is in your future, then so is a pointing device. Ditto for CAD, paint, and drawing programs. Even if you have but two hands.

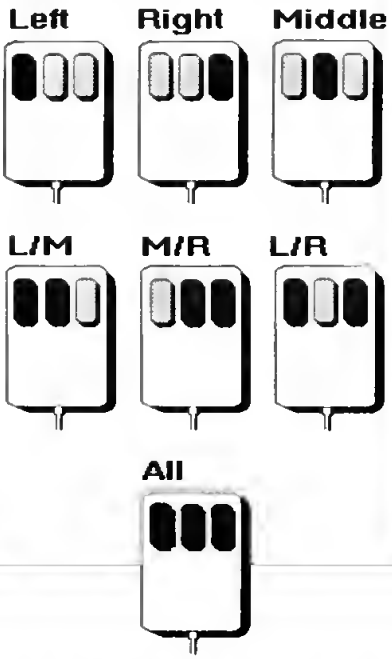
HOW MANY BUTTONS? Steve Jobs apparently never had much faith in the manual dexterity of computer users. The mouse on the "computer for the rest of us" Macintosh is the model of both simplicity and backwardness, like ballots in Russia: one button, one choice. Pretty simple, huh? Point to the pencil icon, click, and you're in the word processor. Point to the trash can, click, and it's zapped.

The two-button mouse was a major improvement because, with just one extra button, you had three choices:



Clicking two or more buttons at the same time is called chording, and not everyone has the rhythm to do it right. Ditto for multiple clicks on a single-button mouse to make up for the lack of a second button.

The three-button mouse went an order of magnitude further—seven choices, including chording:



A handful of mice have four or more buttons, mostly on dedicated workstations (the MultiMouse has six), but on PCs you'll mostly see two or three buttons.

When Microsoft threw itself into the two-button camp, that pretty much settled the issue. Most software that takes advantage of mice doesn't do much with the third button. Often it's used to mean the same as simultaneously clicking both buttons on a two-button mouse.

Bill Verplank of ID Two, a San Francisco industrial design firm, spent 7 years at Xerox PARC (Palo Alto Research Center) when Xerox was doing the seminal work on icons, user interfaces, and pointing devices (which made money for everybody except Xerox). He says research suggests that two buttons are the best compromise for the greatest number of users. According to Verplank:

■ One-button mice are easiest for beginners, who quickly outgrow them. To compensate for the solitary button, they force you into multiple clicks or keyboard button/mouse click combinations, both of which have their own potential for errors. *PC Magazine*'s John C. Dvorak, who has his roots in both the Apple and MS-DOS communities, swears by one button.

■ Two-button mice are best for the broad range of professionals who may alternate among programs. Users quickly get the hang of two buttons, says Verplank: the first (usually the left button) makes a selection and the second adjusts a selection. To get more selections, your left hand can hold the Shift, Alt, or Ctrl key while your right hand clicks the mouse button.

About two-thirds of left-handers use mice with their right hands. If you want to use your left hand and click the main button with your index finger (in this case, the right button), some programs let you swap left and right buttons.

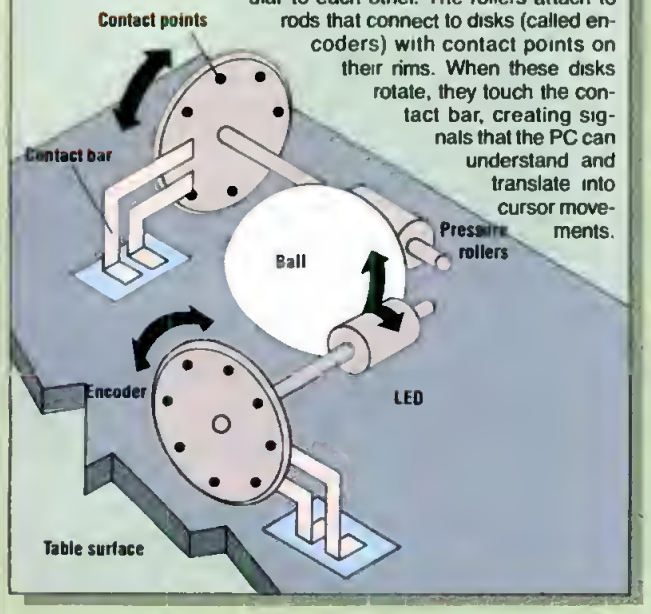
■ Three-button mice overwhelm users, especially at first, Verplank says. Users are prone to clicking the wrong buttons. The three choices (seven if you include chording) do have benefits for the single-task professional—for instance, someone who uses *AutoCAD* or a desktop publishing program all day long.

The Microsoft-IBM market dominance means that three-button mice, even if they are a better idea (you can always *ignore* the

How a Mouse Works

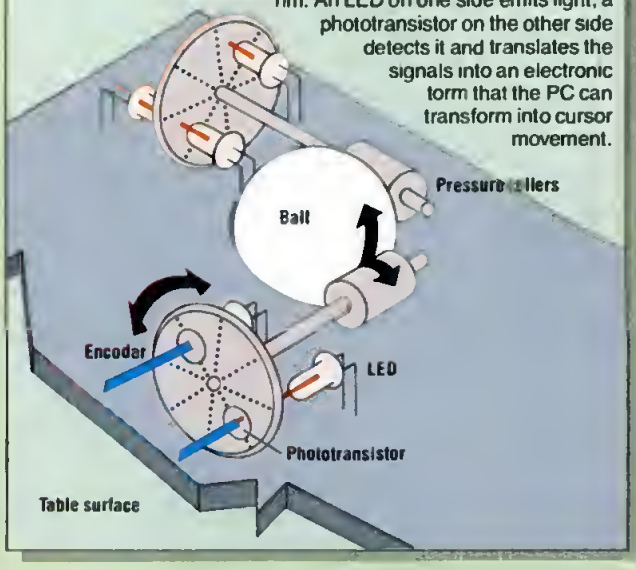
MECHANICAL MOUSE

The mechanical mouse uses a roller ball. As you move the mouse, the ball turns pressure rollers, placed perpendicular to each other. The rollers attach to rods that connect to disks (called encoders) with contact points on their rims. When these disks rotate, they touch the contact bar, creating signals that the PC can understand and translate into cursor movements.



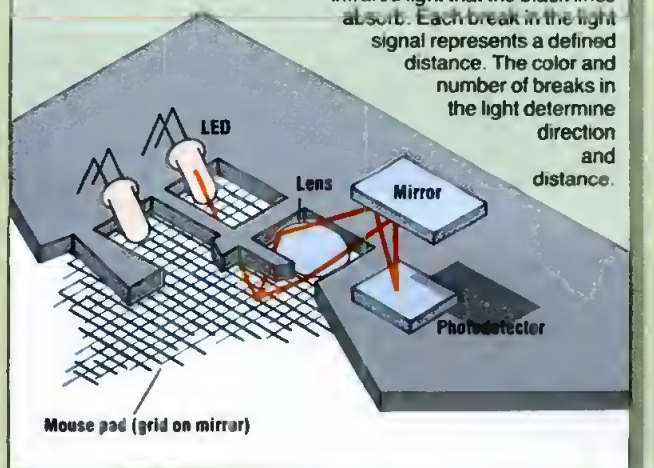
OPTO-MECHANICAL MOUSE

The optomechanical mouse uses the same principles as the mechanical mouse but detects the motion of the encoder disks differently. The disks have evenly spaced slots cut out around the rim. An LED on one side emits light; a phototransistor on the other side detects it and translates the signals into an electronic form that the PC can transform into cursor movement.



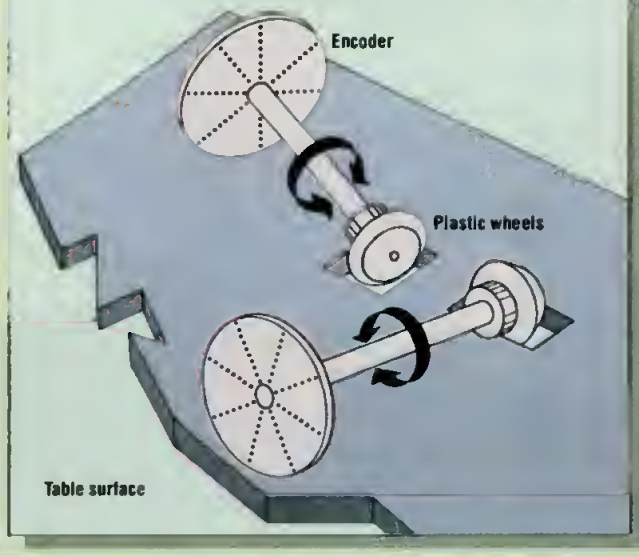
OPTICAL MOUSE

The optical mouse uses a special pad with a reflective surface and grid lines to detect motion and transform it into cursor movement. Lines in one direction are blue, those in the other black. On the bottom of the mouse are two LEDs that emit light, and two phototransistors that receive the light bounced back. One LED emits red light that the blue lines absorb; the other produces infrared light that the black lines absorb. Each break in the light signal represents a defined distance. The color and number of breaks in the light determine direction and distance.



WHEEL MOUSE

The two-wheel mouse operates in the same way as a mechanical mouse, except that a ball does not rotate against the table and pressure rollers; rather, the pressure rollers themselves are tilted down and exposed to the surface, passing motion directly to the encoder disks.



middle button), may never evolve as the dominant mice and that few programs will ever assign a serious function to the middle button.

With mice, in addition to the number of buttons, you also have to choose from among bus, serial, and special-connector (InPort, IBM pointing device) versions, and from among mechanical, optomechanical (basically a mechanical mouse gone fancy), and optical mice. There also are considerations of cord length, mouse shape, and what comes bundled free with the mouse. Here's a quick rundown:

■ **Bus vs. serial vs. special connector.** The bus mouse takes up an expansion slot in your PC. The serial mouse steals one of the two COM ports. Which you choose often depends on whether you're running out of slots or COM ports. Microsoft says serial and bus mice sales run about 50-50 (the bus mouse lists for $20 less). The special-connector mice include Microsoft's InPort spec, which hasn't gotten much support except on Microsoft's Mach 10 PC turbo board, and the new IBM connector, which could take off. Compaq nearly put the InPort connector on its Deskpro 386 last September but backed off when it couldn't lick emissions problems. The mouse cord acted as a broadcast antenna for signals inside the system unit.

■ **Mechanical vs. opto-mechanical vs. optical.** Mechanical mice (Microsoft, IBM, American, Manager) have rubber-like roller balls. As you move the mouse, a sensor translates the left-right and up-down motions into signals corresponding to finely tuned cursor movements. Torrington's Manager Mice use a horizontal roller and a vertical roller instead, claiming that they eliminate the dirt buildup on roller ball mice. Big deal.

An optomechanical mouse (from Logitech and American West Engineering) uses an optical device to sense the mechanical motion of the ball.

The optical mouse (from Mouse Systems and Summagraphics) sits over a pad that looks like a cross between a mirror and ultrafine graph paper. The optical sensor records movement as the mouse passes over the etched lines.

How well the mouse records motion is expressed in its resolution. Some early mice had only 60 dots per inch, some PC mice started out at 100 dpi, and good mice now resolve 200 dpi. Logitech has been talking of a 320-dpi mouse for some time.

At the risk of generating angry letters from techno types at Logitech, Mouse Systems, and Microsoft, the difference in tracking technologies was best expressed by Bill Murray in the forgettable summer-camp movie *Meatballs*: "It just doesn't matter. It just doesn't matter."

More-important considerations are the ones the mouse manufacturers downplay:

■ **Cord length.** For too long, mouse cords (also printer, modem, keyboard, and so on) have been too short at 5 to 6 feet, especially with more PCs being tucked under the desk. The longest cord is the best cord, and IBM leads the way with a 9-footer. A couple of mice actually have two cables—signal and power—and one has none, the Manager Mouse Cordless.

■ **Free software.** Most mouse vendors toss in a paint or drawing program. One of the best deals is Microsoft's bundling of the Brightbill-Roberts *Show Partner* screen animator.

■ **Shape, feel.** You'll quickly adapt to most any mouse design, but some users initially find they prefer the roundish, aerodynamic look of a Microsoft mouse to the cigarette pack feel of a Logitech or Mouse Systems mouse. Some feel the other way.

■ **Smooth button movement.** If the buttons are stiff, you'll have trouble releasing a mechanical mouse without the icon jumping a few pixels away from where you intended. The fault may not lie so much with the mouse as with a too-slippery plastic laminated desktop; if so, buy a mouse pad that adds rolling friction.

■ **Emulation.** All mouse makers know who's number one (Microsoft), so they include at least two mouse driver emulations: their own, Microsoft Mouse emulation, and sometimes Mouse Systems emulation. Some emulations are a bit clunky, although most have improved in the past few months. Applications programs (paint, CAD, *Windows*) also include the mouse drivers. With most mice, you activate the mouse either by MOUSE <Enter> (to load MOUSE.COM) or by including a driver in the CONFIG.SYS file (DEVICE=MOUSE.SYS).

■ **Applications.** Most any program, even MicroPro's rodent-phobic *WordStar*, can be used with a mouse for blocking out text and making menu selections. Mouse vendors often include prebuilt menus for popular programs and guidelines for writing your own. Their usefulness varies widely. For instance, move the pointer too quickly against the left or top border of *1-2-3* and the program responds by beeping over and over. If you've got a favorite program you're dying to use with a pointing device, make sure there's a menu already written (first choice) or a menu generator available (second choice).

In the reviews that follow, you'll see how the actual mice on the market work and how they stack up against each other. The reviews are arranged in alphabetical order by company name—**Bill Howard**

AMERICAN COMPUTER AND PERIPHERAL INC.

If the term *black sheep* describes an unruly member of the family, then *black mouse* describes the American Mouse because it can do no right. The $125 American Mouse, a bus-mounted device from American Computer and Peripheral, is unconventional, difficult to install, and compatible with only a few programs. And don't look to the documentation for any answers, because that brief 12-page booklet doesn't provide much more than hardware installation instructions.

The American Mouse is a three-button

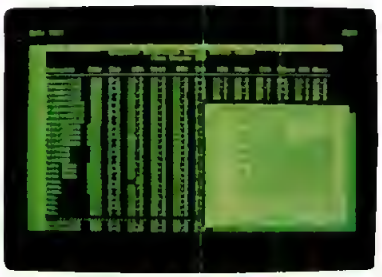
PC MAGAZINE FACT FILE

American Mouse
American Computer and Peripheral Inc.
2720 Crody Way
Santa Ana, CA 92704
(714) 545-2004
List Price: $125
Requires: 128K RAM, half-slot, DOS 1.0 or later.
In Short: A three-button bus mouse that comes with a paint program. The American Mouse is compatible with Mouse Systems drivers but not the Microsoft Mouse and hasn't any predefined menus or a menu generator; the manual is not much of a help.

CIRCLE 646 ON READER SERVICE CARD

Hercules Runs Lotus Better.

In 1982, Hercules first made it possible for 1-2-3 to display graphs on an IBM PC's monochrome monitor. We improved the performance of Lotus software then, and we do it now in powerful, new ways.



1-2-3 displays nearly twice the data with no loss in scrolling speed, plus a pop-up graph window, using the Hercules RamFont mode.

Here's How.

High Resolution Graphics: Lotus software benefits from Hercules' crisp 720x348 resolution—the highest popularly supported standard—in monochrome or full color.

RamFont: Hercules' exclusive new mode improves the text processing performance of many Lotus programs by letting them display up to 3,072 software definable characters instead of the fixed 256 ASCII character set.

Mono & Color Compatibility: You get the most from your Lotus programs because our Graphics Card Plus and new InColor Card are completely compatible with each other. So you can easily move your software from mono to color systems and back again, without worrying about video drivers. And the InColor Card will run the thousands of programs that run on our monochrome cards.

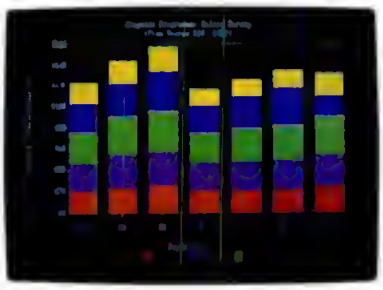
Better Looking 1-2-3 and Symphony.

Lotus 1-2-3 (2.0) and Symphony use RamFont to nearly double data display from 2,000 to about 3,400 characters by expanding the spreadsheet from 80 columns by 25 rows, to 90 columns by 38 rows—with no loss in scrolling speed. The ability to see more data on screen is a powerful advantage to spreadsheet users.

RamFont also allows you to pop-up a graph window right on your 1-2-3 spreadsheet.

RamFont Optimizes Manuscript.

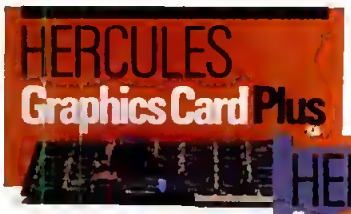
Only Hercules RamFont lets Lotus Manuscript display italics, subscripts, superscripts, other attributes and many equations in the text-processing mode. Manuscript also uses our high resolution graphics for its "page preview" feature.



Hercules 720x348 graphics are the highest popularly supported resolution—15% higher than EGA.

And, of course, Hercules graphics cards run all other Lotus programs such as HAL, Freelance, and Measure. In fact, we'll make most popular software programs run better or look sharper on your IBM PC/XT/AT or compatible.

So specify a Hercules Graphics Card Plus or a Hercules InColor Card for your system and maximize the potential of the Lotus family of software. You'll see for yourself that it simply runs better.



Hercules Graphics Card Plus
(For monochrome monitors)
Includes the three modes your software needs most.

- *Standard Text—For thousands of text-based programs*
- *Hercules 720x348 graphics—highest popularly supported standard*
- *Hercules RamFont—3,072 software definable characters improve many popular software programs. (Call for the latest list.)*
- *$299 suggested U.S. retail price*

Hercules InColor Card
(For multi-sync and enhanced color "EGA-type" monitors.)
Runs all Hercules monochrome software in 2 colors, most popular software in up to 16 colors selected from a palette of 64.

- *Standard Text—All programs run in 2 or more colors.*
- *Hercules 720x348 graphics in up to 16 colors—15% higher resolution than EGA.*
- *Hercules RamFont—3,072 software definable characters in 16 colors up to 12,288 in 2 colors.*
- *$499 suggested U.S. retail price.*

For more information call Hercules toll-free at 1-800-532-0600 Ext. 302.
In Canada, 1-800-323-0601 Ext. 302.

Hercules
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CIRCLE 142 ON READER SERVICE CARD

mechanical mouse. It comes with a Mouse Interface Adapter (RS-232C port) that can be configured to either COM1 or COM2. It also contains another cable that lets you use an existing port if your hardware setup already takes up two COM ports. But to do so, you have to install the adapter and run a cable from the Mouse Interface Adapter to the COM port. Are you confused yet? Well, just wait.

After you have set up the hardware, run the included test program to make sure your mouse is on the right COM port and that the jumpers are set right. However, though the test worked fine on a 6-MHz AT, when I ran it on an 8-MHz AT, my results were inconsistent: in three trials, the program hung up my computer once.

The mouse comes with *Compu-Brush*, which is a rebundled version of *PC Paint*. Although not mentioned in the manual, the technical department at American Computer and Peripheral told me that the mouse is compatible with both the Microsoft and Mouse Systems mice.

But while the American Mouse ran smoothly with *Compu-Brush*, it didn't work with *Microsoft Word* or *Windows*. The American Mouse does not come with drivers for *1-2-3*, nor does it include a menu maker so that you can create your own drivers.

The mouse did work with *1-2-3*, *Windows* and *Microsoft Word* when tested using Mouse Systems drivers. But to get the Mouse Systems drivers, you have to own the Mouse Systems mouse. So why would you buy the American Mouse?

—Christopher Barr

From left to right: American Computer and Peripheral's American Mouse, American West Engineering's MultiMouse, and the IBM PS/2 Mouse for PS/2 computers.

AMERICAN WEST ENGINEERING

MultiMouse

At first glance, the MultiMouse appears to be simply an oversized, over-buttoned mutant of the mouse strain—a slum-sized rat among field mice.

Upon closer inspection, however, you might find that the $289 MultiMouse is the answer to your input problems. It serves quite nicely as a mouse, but you can also use it to enter any character or control code that you'd normally type at the keyboard. American West Engineering uses the Logitech mouse, including Logitech's software, as a component in its overall system. The company then adds the text capability and the interface to the Logitech mouse.

The MultiMouse is about the size and shape of half a large grapefruit. With your hand resting atop the curve, each of your fingers operates one button. Your thumb operates the two buttons on the vertical surface of the mouse (American West offers both a left- and a right-handed model).

American West designed the MultiMouse for professionals who work primarily with mouse-intensive graphics packages. The idea isn't to replace the keyboard for heavy text entry, but rather for minimal text entry that normally requires an irritating trip to the keyboard.

To handle its impressive range of capabilities with only six buttons, the MultiMouse operates in three modes. You switch between modes on the fly by depressing the appropriate button combination. Mode 1 gives you the alphabetic characters and some punctuation. Mode 2 accesses numeric characters and the remaining punctuation. Mode 3, using only three of the six buttons, provides mouse functions.

To install the MultiMouse, you plug its 4½-foot cable into a 9-pin serial connector. Two short cables with keyboard connectors lead from the serial plug. You plug one of these connectors into your system's keyboard jack and your keyboard into the other.

Since the MultiMouse is actually a Logitech mouse, its ability to work with specific software packages should be identical. To use the mouse with mouse-based software, you choose the Logitech mouse during the software's setup procedure. To use the MultiMouse with applications that

PC MAGAZINE FACT FILE

MultiMouse
American West Engineering
2144 S. 1100 East, #150
Salt Lake City, UT 84106
(801) 484-1973
List Price: $289
Requires: 256K RAM, serial port, DOS 2.0 or later.
In Short: A large, six-button mouse that also lets you enter characters without touching your keyboard.

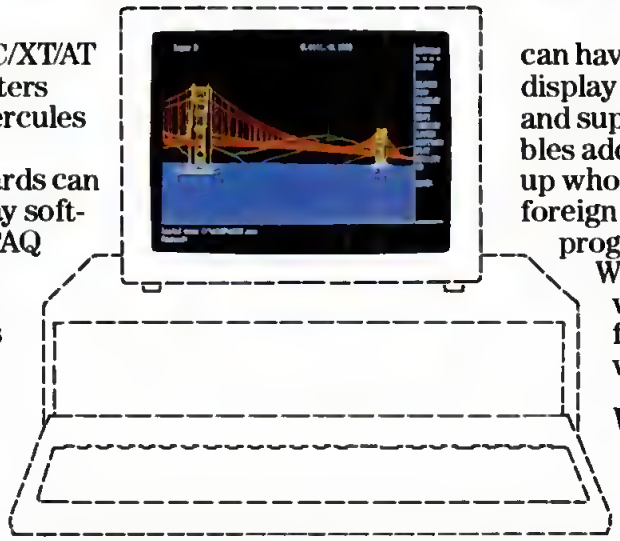
CIRCLE 645 ON READER SERVICE CARD

Photograph: Roberto Brosan

De-clone Your Compatible With Hercules.

Most popular IBM PC/XT/AT compatible computers really stand out with Hercules Graphics Cards.

That's because our cards can actually improve the way software runs on the COMPAQ DeskPro 286/386, Leading Edge Model D, and IBM compatible models from Epson, Hewlett-Packard, Kaypro, NCR, Tandy, Zenith, and many others.



Hercules 720x348 resolution and RamFont are now available in up to 16 colors on your multi-sync or "EGA Type" monitor.

Three Modes You Need for Your Software.

Both the Hercules Graphics Card Plus (for TTL monochrome monitors) and new Hercules InColor™ Card (for multi-sync and enhanced color "EGA type" monitors) contain the three modes you need to get the most out of software on your compatible.

High Resolution Graphics: Your PC benefits from Hercules' crisp 720x348 resolution—the highest popularly supported standard—in monochrome, or up to 16 colors.

RamFont™ Mode: This powerful new mode allows popular programs to display up to 3,072 software definable characters instead of the fixed 256 ASCII character set.

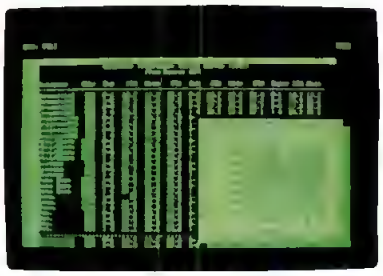
Text Mode: Thousands of standard text programs run on both Hercules cards.

With RamFont, Lotus 1-2-3 and Symphony display nearly twice their regular spreadsheet data... with no loss in scrolling speed. Microsoft Word runs up to four times faster. Lotus Manuscript, and many other word processors, can have the true text speed display of italics, subscripts and superscripts. And, it enables add-on packages to open up whole new areas of font and foreign character display for programs like WordPerfect, WordStar, and Multimate; while providing powerful capabilities for software of the future.

We Love Compatibility

Our Graphics Card Plus and new InColor Card are completely compatible with each other. So you can easily move your software from mono to color systems and back again without worrying about video drivers.

So to get the most out of your software, specify a Hercules Graphic Card Plus or a Hercules InColor Card for your system. And make your compatible more than a clone.



Hercules cards with RamFont let 1-2-3, and other popular spreadsheets, display nearly twice the data with no loss in scrolling speed.

Hercules Graphics Card Plus
(For monochrome monitors)
Includes the three modes your software needs most:
- *Standard Text—For thousands of text-based programs*
- *Hercules 720x348 graphics—highest popularly supported standard*
- *Hercules RamFont—3,072 software definable characters improve many popular software programs. (Call for the latest list.)*
- *$299 suggested U.S. retail price.*

Hercules InColor Card
(For multi-sync and enhanced color "EGA-type" monitors.)
Runs all Hercules monochrome software in 2 colors, most popular software in up to 16 colors selected from a palette of 64.
- *Standard Text—All programs run in 2 or more colors.*
- *Hercules 720x348 graphics in up to 16 colors—15% higher resolution than EGA.*
- *Hercules RamFont—3,072 software definable characters in 16 colors up to 12,288 in 2 colors.*
- *$499 suggested U.S. retail price.*

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CIRCLE 142 ON READER SERVICE CARD

support the Microsoft Mouse, you simply run Logitech's universal mouse driver. The MultiMouse also includes Logitech's Mouse Menu software and drivers for some keyboard-based software packages, including *1-2-3*, *Multiplan*, and *MultiMate*.

I had no problem using the MultiMouse with packages that support a Microsoft Mouse, such as *Freelance Plus* and *EGAPaint*, or with programs that include a Logitech driver, like *Microsoft Windows*. However, I wasn't able to persuade *Microsoft Word*, Version 3.1, to recognize the MultiMouse.

Entering characters with the MultiMouse is a breeze once you get the hang of it. An 8½ by 11-inch laminated reference card clearly shows the button combinations for all keyboard functions, and after about 15 minutes of use I began to remember the button combinations for some characters. But don't expect to whip out 60 characters per minute, even once you've learned the button combinations: American West reports that the product's designer, a regular user of the MultiMouse, is up to about 20 words per minute. You can still use your keyboard when using MultiMouse in any mode.

All in all, I liked the MultiMouse—even for use as only a mouse. Though you'd think its bulk would be a drawback, I actually preferred the MultiMouse over smaller mice once I became accustomed to it. Holding and moving the mouse felt natural and comfortable, and I didn't have to grope for the buttons. And while American West supplies a pad, the rubber-coated roller ball moved smoothly even without it.—**Mitt Jones**

IBM CORP.

IBM PS/2 Mouse

IBM Corp. announced the Personal System/2 Mouse in April along with the stars of the PS/2 line—the Model 30, 50, 60, and 80 personal computers. And IBM is charging only $95 for this mouse. The IBM PS/2 Mouse and the Microsoft Mouse with a PS/2 adapter earn the distinction of being the only mice that are currently compatible with the PS/2 line of computers.

As has so often been the case with products from IBM, the PS/2 Mouse deserves a few cheers and a few jeers.

PC MAGAZINE FACT FILE

IBM PS/2 Mouse
IBM Corp.
Old Orchard Rd.
Armonk, NY 10504
(914) 765-1900
List Price: $95
Requires: 8K RAM; IBM PS/2 Model 30, 50, 60, or 80; OS/2 or DOS 3.3 for PS/2 Model 30
In Short: Scant software and documentation blemish an otherwise excellent two-button mouse.
CIRCLE **642** ON READER SERVICE CARD

The good news is that somebody finally made a mouse with a long cord—a nice touch for those who like to tuck their CPUs under their desk. The PS/2 Mouse wags a seemingly endless 9-foot tail.

The bad news? IBM supplies a Microsoft Mouse–compatible driver, but that's it. I searched in vain for a *1-2-3* driver and for software that would let me build my own drivers. And don't expect much help from the eight-page documentation—eight pages if you include the cover, the two pages explaining the limited warranty, the one-page FCC statement, and a blank page for notes. A portion of the PS/2 computer manual documents mouse testing.

The two-button mechanical mouse takes less than 30 minutes to install. You simply plug the cord into the Pointing Device Connector on the back panel of the computer. A brief software installation procedure copies the mouse driver to your hard disk.

I installed the mouse on a Model 60, and it worked beautifully and without a fuss with *Microsoft Windows*, *Microsoft Word*, *EGAPaint*, and *Freelance Plus*.

The PS/2 Mouse departs from the box-like shape of most mice. IBM designed the narrow, rounded rear to fit nicely into the palm of your hand. I found this shape to be much more comfortable than the shallow, squarish Logitech design, but not as comfortable as the larger, bulbous shape of the Microsoft Mouse.

Mechanically, the PS/2 Mouse is tops. The rubber-coated ball rode the mouse smoothly over my cluttered desk, and the pointer glided nicely about the screen.

Were it not for the fact that it works only with PS/2 computers, the PS/2 Mouse would be a steal for anyone at its $95 list price.—**Mitt Jones**

IMSI

IMSI (International Microcomputer Software Inc.) licenses two mice, the IMSI Mouse, a $99 disaster from Kraft Systems, and the IMSI OptiMouse, a $159 beauty made by Mouse Systems.

The IMSI OptiMouse is reviewed in this article as Mouse Systems Corp.'s PC Mouse and is highly recommended for its trouble-free performance. But the IMSI Mouse is more trouble than it is worth. First off, it could be better designed ergonomically: the mouse's three buttons are packed closely together in a row and feel uneven to the touch.

The mouse also requires a separate power supply that adds to the confused tangle of cables running to the back of your

PC MAGAZINE FACT FILE

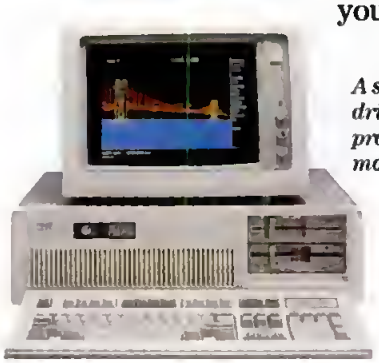
IMSI Mouse
IMSI
1299 Fourth St
San Rafael, CA 94901
(415) 454-7101
List Price: $99
Requires: Less than 10K RAM, serial port, DOS 2.0 or later.
In Short: The three-button IMSI Mouse is a cheap, poorly made mechanical mouse with inaccurate documentation
CIRCLE **644** ON READER SERVICE CARD

IMSI OptiMouse
IMSI
1299 Fourth St.
San Rafael, CA 94901
(415) 454-7101
List Price: $159
Requires: 64K RAM, serial port DOS 2.0 or later.
In Short: The three-button IMSI OptiMouse is a well-made optical mouse that performs flawlessly. (The same product as Mouse Systems Corp.'s PC Mouse.)
CIRCLE **643** ON READER SERVICE CARD

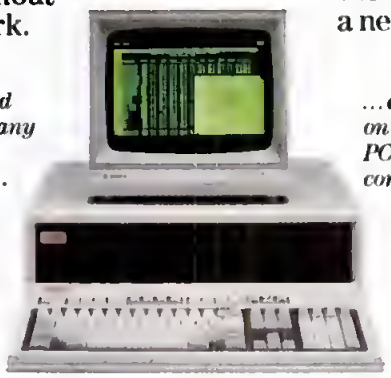
Networks Love Hercules.

Mono to Color Compatibility Make Driver Worries a Thing of the Past.

If you're trying to tie together your IBM compatible PCs, you don't need us to tell you about the hassles of different kinds of color and monochrome monitors and graphic cards requiring different video drivers for different software spread throughout your network.



A single unified driver runs many programs in monochrome...



...and in full color on different PC/monitor combinations.

installed with the program at the file server will work with both your mono and color PCs. And that's one less thing to worry about.

We Run Software Better.

That great compatibility and unified driver concept is just one of the ways we improve the way software runs, on or off a network.

Hercules can make your life a bit easier. And while we're at it, improve the way your software runs. Our suggestion:

You've probably already standardized on Hercules cards for your *monochrome* PCs. We suggest you also standardize on Hercules for your *enhanced* color systems.

Good-bye Driver Worries.

Our new InColor Card is fully compatible with Hercules monochrome cards. This means it will run every one of the thousands of programs written for those cards in two colors, using the standard monochrome driver included with the software.

And most popular programs... like 1-2-3, Symphony, Framework, AutoCAD, and many others use a single driver to run in full color (up to 16 colors selected from a palette of 64) on our InColor Card, and in mono on our monochrome cards.

What it all adds up to is this: If you've standardized on Hercules, a single driver

Your software also benefits from Hercules' crisp 720x348 resolution—the highest popularly supported standard in monochrome or full color.

And Hercules exclusive RamFont mode improves the performance of spreadsheets and word processors (1-2-3, Symphony, Framework, Word, Manuscript, and many others) by letting them display up to 3,072 software definable characters instead of the fixed 256 ASCII character set.

So, to get the most from your software and your network, specify the Hercules Graphics Card Plus, or the Hercules InColor Card for your systems. Your network will love you for it.

Hercules Graphics Card Plus
(For monochrome monitors)
Includes the three modes your software needs most:
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- *Hercules 720x348 graphics—highest popularly supported standard*
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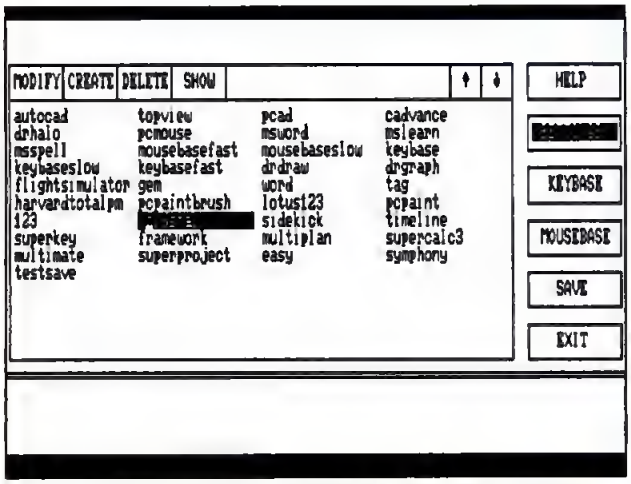
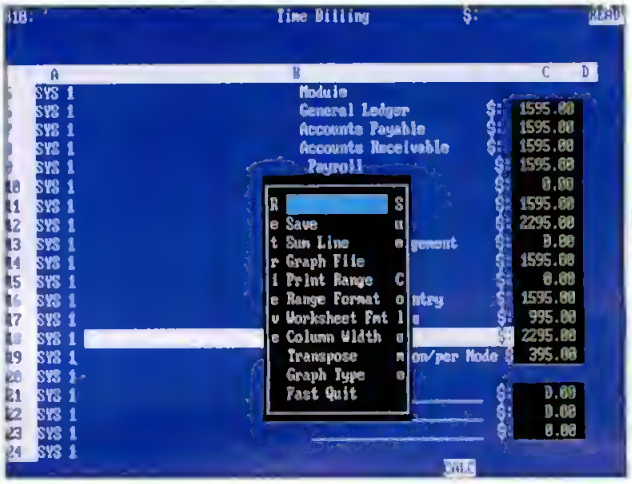
MENUS FOR MICE, PART 1



American West Engineering's MultiMouse comes with Logitech's Mouse Menu software and drivers for some keyboard-based software packages such as 1-2-3, Multiplan, *and* MultiMate.



To use the 1-2-3 *menu supplied with the Logitech Bus Mouse and Serial Mouse, you type m123 at the DOS command line. Selecting "Exit" on the menu quickly brings you back to DOS.*

In order to use the $99 IMSI Mouse with software programs that do not have mouse support, you must use the menu maker utility to create a menu that can be displayed on top of the program.

The software installation procedure for the Maynard Electronics Mouse lets you call your applications programs through CustomKey's DOS menu without changing subdirectories.

We Make Desktop Publishing Easy!

The most widely accepted desktop publishing software with state-of-the-art hardware for cost-effective desktop publishing solutions, all preconfigured and ready to go.

Desktop Publishing Solutions

The term WYSIWYG (What-You-See-Is-What-You-Get, pronounced whizzywig) refers to the representation of text and graphics on a computer terminal just as they would appear on the printed page.

WYSIWYG systems save you time, effort, and money in your document production. That's why we chose WYSIWYG for the name of our company.

Easy Installation

You don't have to be a hardware or software expert to get started with your WYSIWYG system. Each WYSIWYG system is fully preconfigured: the hard drive is formatted, and DOS, the hardware drivers and software for your basic system are already installed.

You can replace the Aldus Pagemaker and Microsoft Windows software with Xerox Ventrua Publisher in any WYSIWYG system, at no extra charge. Ask about our business leasing.

System One

High-Speed DP-286 (10MHz) Intel 80286-based IBM® -AT compatible computer with 1MB of RAM and Phoenix ROM BIOS. System features AT-style keyboard and mouse, 1.2MB diskette drive, 200-watt power supply, clock/calendar with battery backup, and MS-DOS, version 3.2.

Twelve-Inch, High-Resolution Flat Screen monochrome monitor (720 × 350 pixels). Ergonomically engineered non-glare monitor is mounted on a tilt and swivel base for comfort and reduced eye strain.

Second-Generation Hewlett-Packard LaserJet Series II laser printer with cable and 512KB print buffer (expandable to 4.5MB). The versatile 8-page-per-minute Series II prints a range of page sizes.

Formatted 20MB Seagate fixed drive. This high-speed drive (65-millisecond average-access-time) is shock resistant for rugged use.

Aldus PageMaker, the program that started the desktop publishing revolution. Build graphic elements, create or change fill patterns, line widths, type styles and sizes, and wrap text around graphic elements. Create and store formats for newsletters, textbooks, ads, or other documents.

Microsoft Windows. A multi-tasking, DOS-enhancing environment. Windows includes a word processing program, a paint program, communications manager, alarm clock, calendar, memory manager, card filer, and task switching program.

$3995

24-Month Lease $223 Mo.
36-Month Lease $159 Mo.

System Two

High-Speed DP-286 (10MHz) Intel 80286-based IBM® -AT compatible computer with 1MB of RAM and Phoenix ROM BIOS. System features AT-style keyboard and mouse, 1.2MB diskette drive, 200-watt power supply, clock/calendar with battery backup, and Microsoft DOS, version 3.2.

Full-Page High-Resolution Genius 402 WYSIWYG-Style Monitor (736 × 1008 pixels). This powerful full-page (portrait-screen) monitor displays text and graphics at 100 dots per inch resolution. Special video adapter with parallel printer port is included.

Formatted 40MB MiniSribe fixed drive. Provides high-speed (28 ms) disk accessing for superior performance.

Second-Generation Hewlett-Packard LaserJet Series II laser printer with cable and 512KB print buffer (expandable to 4.5MB). The versatile 8-page-per-minute Series II prints a range of page sizes.

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Microsoft Windows. A multi-tasking, DOS-enhancing environment. Windows includes a word processing program, a paint program, communications manager, alarm clock, calendar, memory manager, card filer, and task switching program.

$5995

24-Month Lease $335 Mo.
36-Month Lease $239 Mo.

Options

Hewlett Packard ScanJet Scanner. This flatbed desktop scanner enables you to add exacting drawings, photographs, logos, or other graphic images to your desktop applications. Scanjet offers exposure, scaling, and resolution controls. An optional 20-page document feeder is available.

$1495 includes interface ($495 value)

Ventura Publisher Software, part of the Xerox Desktop Publishing Series, is one of the best desktop publishing programs available for PC-and AT-class machines. Ventura integrates text and graphics from numerous word processing, graphics, and spreadsheet programs.

$665

Microsoft Word Version 3.2 software is a powerhouse of features and comes with its own on-screen tutorial to help you start working immediately.

$259

2-MB LaserJet Series II Expansion memory board to enhance your new LaserJet **$695**

WYSIWYG

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Technical support 512-331-5085

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How to for what

see VGA it really is.

Take this little test.

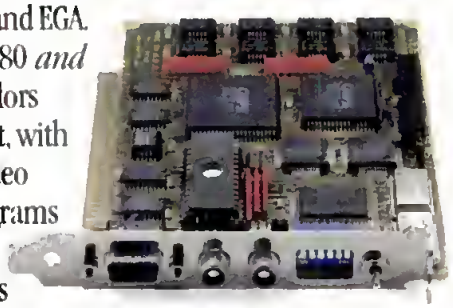
Look at the screen to the left and notice the sharpness of the characters. And the brightness of the colors.

And the name of the standard. VEGA Deluxe.™

This is the 640 x 480 high resolution graphics standard that IBM thought so highly of they decided to build it into their own new Personal System/2 computers.

But if you've already got a PC or compatible and a MultiSync monitor, then all you need is the $495 VEGA Deluxe card.

The VEGA Deluxe is a standard that over 100,000 users have already adopted in their own PC systems. A standard that runs every piece of software written for CGA, MDA, Hercules and EGA.



A standard that offers 640 x 480 *and* 752 x 410 resolutions, with 16 colors from a palette of 64. And one that, with a free software upgrade from Video Seven, will run most future programs written for IBM's VGA.

Oh sure, the VEGA Deluxe uses advanced surface mount technology. (IBM thought that was a good idea, too.) And comes with a two year warranty. And has been the recipient of numerous awards for product excellence including Editor's Choice from PC Magazine and the Ultimate Machine from PC Tech Journal.

But don't let that sway you. Instead, just come down to your nearest Video Seven dealer and see for yourself what high resolution really looks like. Or just call 1-800-238-0101 (in California, 1-800-962-5700) for more information.

The VEGA Deluxe. It'll open your eyes.

Video Seven Inc., 46335 Landing Parkway, Fremont, CA 94538.

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CIRCLE 127 ON READER SERVICE CARD

Mice: Summary of Features

(Products listed in ascending price order)

	IBM PS/2 Mouse	IMSI Mouse	Logitech Serial Mouse	Logitech Bus Mouse	SummaMouse	American Mouse	IMSI OptiMouse
List price	$95	$99	$99	$119	$119	$125	$159
Position sensor	Mechanical	Mechanical	Optomechanical	Optomechanical	Optical	Mechanical	Optical
Interface	PS/2 Pointing Device Connector	Serial	Serial	Bus	Serial	Bus or serial	Serial
Has interface for IBM PS/2	●	○	○	○	○	○	○
Number of buttons	2	3	3	3	3	3	3
Power supply	Internal	External	Internal	Internal	External	Internal	Internal
Cord length (inches)	108	57	72	48	59	60	60
Menu generator	○	●	●	●	●	●	●
Software included	None	None	24 predefined menus	24 predefined menus	3 predefined menus	*Compu-Brush*	18 predefined menus
Mouse emulation	Microsoft	Microsoft	Microsoft, Mouse Systems, Torrington, Summa	Microsoft, Mouse Systems, Torrington, Summa	Microsoft, Mouse Systems	Mouse Systems	Microsoft, Mouse Systems

Applications Supported

	IBM PS/2 Mouse	IMSI Mouse	Logitech Serial Mouse	Logitech Bus Mouse	SummaMouse	American Mouse	IMSI OptiMouse
Microsoft Windows	●	●	●	●	●	●	●
1-2-3	●	●	●	●	●	○	●
Microsoft Word	●	○	●	●	○	●	●
WordStar	●	●	●	●	●	○	●
WordPerfect	●	●	●	●	●	○	●
AutoCAD	●	●	●	●	●	●	●
VersaCAD	●	●	●	●	●	●	●
PC Paintbrush	●	●	●	●	●	●	●
Freelance Plus	●	●	●	●	●	●	●
Dr. Halo	●	●	●	●	●	○	●
PageMaker	○	●	●	●	●	○	●
Ventura Publisher	○	●	●	●	●	●	●

—Indicates Editor's Choice ●—Yes ○—No *Uses perpendicular roller design.

computer. The IMSI Mouse connector plugs into an RS-232 port and can use COM1 or COM2. It draws power from an additional transformer that plugs directly into the connector.

In addition, the IMSI Mouse is not fully Microsoft Mouse compatible since it doesn't work with *Microsoft Word* (though the documentation claims otherwise, a call to the vendor confirmed the incompatibility).

The software also comes with a driver that you use with pop-up menus that you write yourself, and one for *Microsoft Windows*. The mouse also supports *Dr. Halo II*, *Microsoft Flight Simulator*, and *GEM* from Digital Research. The IMSI Mouse worked fine with *PC Paint*, *1-2-3*, and *Windows*.

Since many software programs do not support mice, many mouse manufacturers provide predefined menus for the more-popular applications. Not so with the IMSI Mouse. When you use the mouse with software that doesn't already support it, the drivers provided allow you to use your mouse only to move the cursor; to access software commands, you must take the time to write your own menus. The IMSI Mouse has a simple utility that lets you create pop-up menus. As you build a menu, you select the cursor speed and determine where it will pop up on-screen. I easily created a *1-2-3* menu that allowed me to call the program's main menu.

All in all, the IMSI Mouse is nothing short of a nuisance. It takes up a precious spot on my power strip, it adds an additional cable to the rat's nest already behind my computer, it doesn't work with *Word*, and I even have to write a menu to use it with my favorite spreadsheet. If you're going to buy a mouse, stick with the OptiMouse made by Mouse Systems—you won't be disappointed. **—Christopher Barr**

	PC Mouse	Microsoft Mouse, Bus Version	Manager Mouse 1001C-KF	PC Mouse Bus Plus	Maynard Electronics Mouse	Microsoft Mouse, Serial Version	Manager Mouse Cordless	MultiMouse
List price	$159	$175	$179	$179	$185	$195	$229	$289
Position sensor	Optical	Mechanical	Mechanical*	Optical	Mechanical*	Mechanical	Mechanical*	Optomechanical
Interface	Serial	Bus	Serial	Bus	Bus	Serial	Serial	Serial, keyboard
Has interface for IBM PS/2	○	○	○	○	○	○	○	○
Number of buttons	3	2	3	3	3	2	3	6
Power supply	Internal	Internal	Internal	Internal	Internal	Internal	External	Internal
Cord length (inches)	60	60	60	60	60	60	48	60
Menu generator	●	○	○	●	●	○	○	●
Software included	23 predefined menus	3 predefined menus, *Show Partner, Microsoft Paintbrush*	3 predefined button assignments at any one time, *KeyFree, TelePaint*	23 predefined menus, bus set configuration software	10 predefined menus, *TelePaint, CustomKey*	3 predefined menus, *Show Partner, Microsoft Paintbrush*	3 predefined button assignments at any one time, *KeyFree*	None
Mouse emulation	Microsoft	None	Microsoft; hardware-compatible with Mouse Systems	Microsoft	Microsoft	None	Microsoft, hardware-compatible with Mouse Systems	Logitech

Applications Supported

	PC Mouse	Microsoft Mouse, Bus Version	Manager Mouse 1001C-KF	PC Mouse Bus Plus	Maynard Electronic Mouse	Microsoft Mouse, Serial Version	Manager Mouse Cordless	MultiMouse
Microsoft Windows	●	●	●	●	●	●	●	●
1-2-3	●	●	●	●	●	●	●	●
Microsoft Word	●	●	●	●	●	●	●	○
WordStar	●	○	●	●	●	○	●	●
WordPerfect	●	○	●	●	●	○	●	●
AutoCAD	●	●	●	●	●	●	●	●
VersaCAD	●	●	●	●	○	●	●	●
PC Paintbrush	●	●	●	●	●	●	●	●
Freelance Plus	●	●	●	●	●	●	●	●
Dr. Halo	●	●	●	●	○	●	●	●
PageMaker	●	●	●	●	●	●	●	●
Ventura Publisher	●	●	●	●	●	●	●	●

LOGITECH INC.

Logitech Bus Mouse and Logitech Serial Mouse

The Logitech mouse comes in two versions, bus and serial. Both the $119 Logitech Bus Mouse and the $99 Serial Mouse are full-featured and easy to install.

As you would expect, hardware installation differs for the bus and serial versions, but the software and its installation are identical. Installation for both mice is straightforward, largely because of Logitech's excellent documentation. The 175-page manual is well written and complete; it clearly lays out the installation procedures, providing many examples that will help all levels of users.

Logitech uses a hybrid optomechanical technology for its PC rodents. They have the familiar trackball, but the motion of the ball is decoded optically, rather than by a direct electromechanical link.

Because the Logitech Mouse emulates a Microsoft Mouse, PC Mouse, Manager Mouse, or SummaMouse, using it with programs that support a mouse is easy. The Logitech Mouse also comes with six ready-to-use menus for such applications as Lotus's *1-2-3* and *Symphony*, Paperback Software's *VP-Planner*, and Executive Systems' *X-Tree*. The Logitech Mouse Plus package offers additional menu definitions that you must compile and can then use as pop-up menus. It also has a generic menu for use with a number of applications. Including these menus, the Logitech Mouse comes with menus for a total of 24 programs.

I tested the mice on *Microsoft Word* and *Windows*, *EGAPaint*, *1-2-3*, and *Freelance*, and they worked beautifully.

To use the *1-2-3* menu supplied with the mice, for instance, you simply type m123 at the DOS command line. This

EDITOR'S CHOICE

FACT FILE

Logitech Serial Mouse
Logitech Inc.
6505 Kaiser Dr.
Fremont, CA 94555
(415) 795-8500
List Price: $99 (includes driver only); $119 for Plus Package, including driver and menu-generating software.
Requires: 256K RAM, serial port, DOS 2.0 or later.
In Short: This mouse comes with a large number of software drivers; its three-button design provides a good degree of control.
CIRCLE 641 ON READER SERVICE CARD

Logitech Bus Mouse
Logitech Inc.
6505 Kaiser Dr.
Fremont, CA 94555
(415) 795-8500
List Price: $119, Plus Package configuration only.
Requires: 256K RAM, half-slot, DOS 2.0 or later.
In Short: The bus version of the Serial Mouse that is also reviewed here, this mouse has a large number of software drivers. That, combined with the degree of control allowed by its three-button design, makes the Logitech mouse an excellent choice.
CIRCLE 640 ON READER SERVICE CARD

Pictured from left to right are the IMSI OptiMouse and the IMSI Mouse, Logitech's mouse (available in bus and serial versions), and the Maynard Electronics Mouse.

loads a pop-up menu and brings up the spreadsheet. A click of the middle mouse button calls the pop-up menu, which reduces some common spreadsheet operations to a single click. A quick exit selection on the menu will bring you back to DOS with a single click. The right button emulates the Esc key within *1-2-3*, making backing up or correcting mistakes very easy and intuitive. Throughout, cursor movement with the mouse is efficient and flexible.

If the software you want isn't supported by any of the 22 menus, no problem. The Logitech mice also come with an excellent menuing system, LogiMenu, which is actually a language that allows you to define your own applications menus. The LogiMenu language is powerful enough that you can even program submenus and context-sensitive menus.

Logitech's mice also have an exceptionally good feel. They move smoothly across the desktop, with just enough friction to allow for precise, positive control of the cursor. This is due to four small, slightly tacky plastic pads (paws?) mounted on the mouse's underside. However, because of its square shape, the mouse won't fit into your hand as well as it might, which could lead to hand fatigue after long use.

At 4 feet, the bus mouse's cord length is also a bit skimpy. The serial mouse, however, comes with a 6-foot-long cord. The Logitech mice's tails measure about 6 inches shorter than those of their Microsoft counterparts—though that probably won't matter for many applications.

In all, Logitech's large number of software drivers and the control provided by the three-button design make these mice a good choice. But while this mouse glides easily over your desktop, its boxy design might make it rough going on your hand for long runs.—**Jonathan Matzkin**

MAYNARD ELECTRONICS

The Maynard Electronics Mouse uses Torrington's two-wheel roller design. Aside from that, it proved to be an enjoyable product. This $185 three-button bus mouse earned especially high marks for both its excellent software—Maynard's *CustomKey*—and its clear, comprehensive documentation.

CustomKey lets you store up to 16 macros per application in a pop-up menu. You can also assign macros to the seven mouse-button combinations. Maynard even provides a special code you can insert in your macros to call a confirmation menu—in case you worry that your macros will make deleting or overwriting valuable data a mite too easy.

The Mouse Owner's Guide does a nice job of introducing mouse basics and guiding you through *CustomKey*'s features. A separate installation pamphlet includes a step-by-step guide for novices and a quick guide for those more familiar with PC innards.

To install the mouse, you first install the half-length card. But you can't install the card in the XT's finicky eighth slot. As with other bus mice, you may have to reset a jumper on the card, depending on the configuration of your system. Maynard managed to reduce the rules for setting the jumper to a six-line table, but the jumper's

Photograph: Roberto Braun

PC Mouse

Microsoft™

Why you should buy a mouse with no moving parts.

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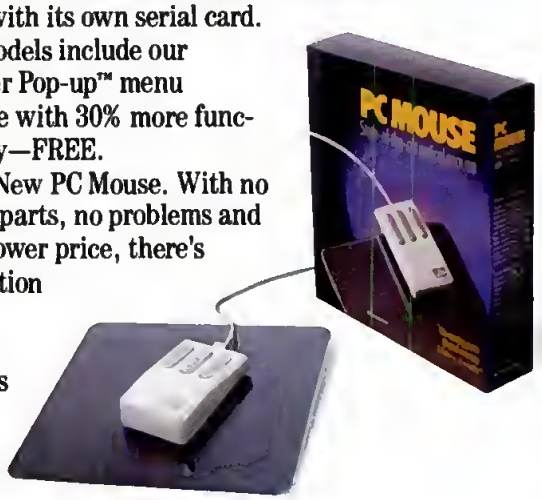

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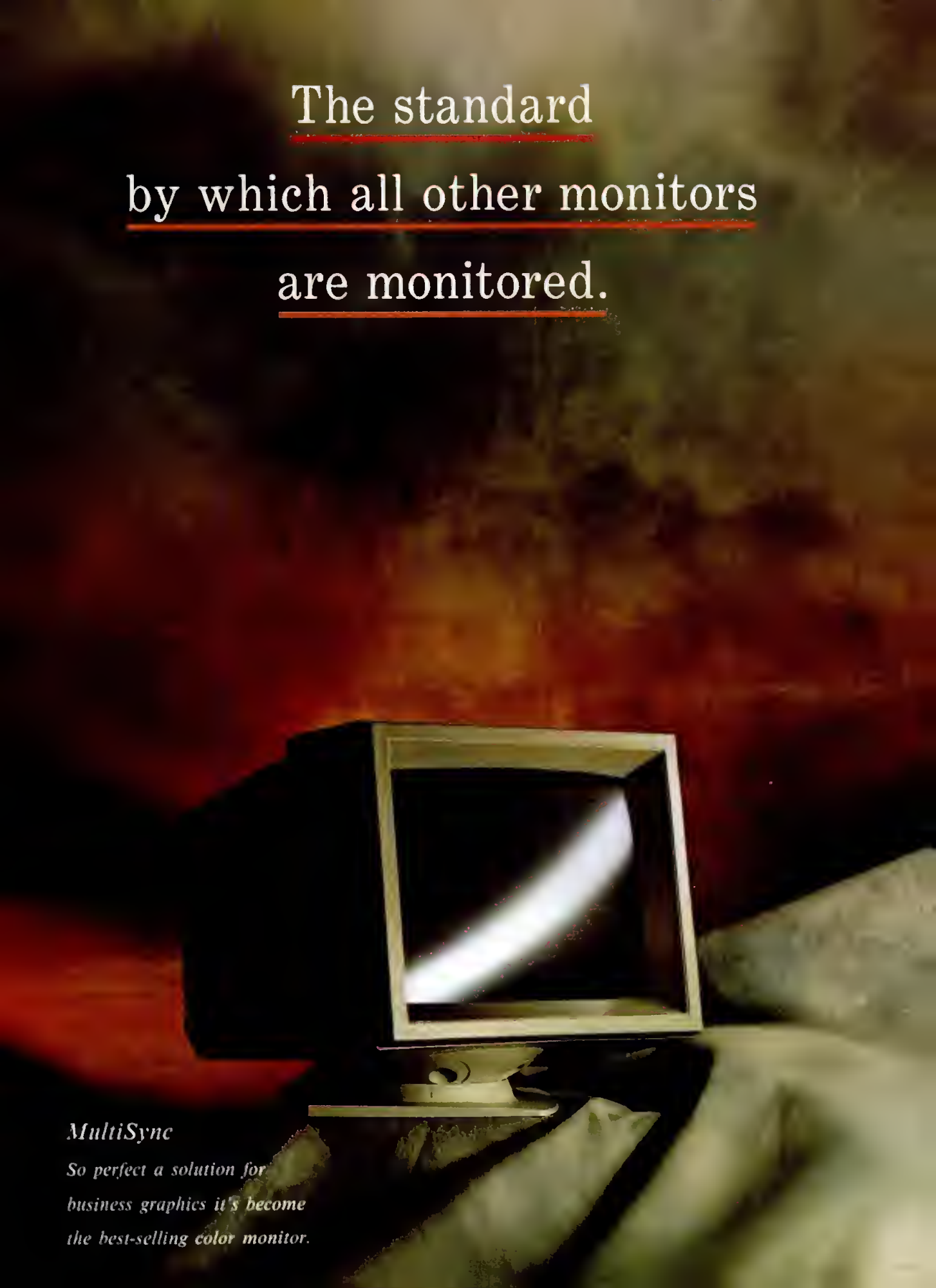

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PC MAGAZINE FACT FILE

Maynard Electronics Mouse
Maynard Electronics
460 E. Semoran Blvd.
Casselberry, FL 32707
(305) 331-6402
List Price: $185; serial version, $170.
Requires: 128K RAM, half-slot, DOS 1.0 or later.
In Short: A three-button, mechanical bus mouse with excellent software and documentation.
CIRCLE 639 ON READER SERVICE CARD

location makes it difficult to reach without a tweezerlike tool.

I installed the Maynard Mouse without a glitch in an IBM PC-XT, and you shouldn't have any problems using it with Compaq, NCR, or AT&T models. However, the mouse wouldn't work properly with two other clones I tried—neither of which Maynard includes in its compatibility list.

Maynard's software installation procedure matches *CustomKey* in both ease of use and flexibility. You can choose how the mouse drivers should be loaded and which predefined applications drivers you want to use. The procedure links each predefined driver to its application, so you can call your applications programs through *CustomKey*'s DOS menu without changing subdirectories.

The mouse worked flawlessly when I used its Microsoft Mouse–compatible driver with most of the software I tried. However, you'll have to install special drivers to use the Maynard Mouse with *Microsoft Windows*, IBM's *TopView*, and a few other packages. Maynard's documentation includes a brief section on loading each of these drivers.

Overall, Maynard has put a great deal of thought and effort into its mouse, and a free copy of LCS/Telegraphics' *TelePaint* adds value to an already reasonably priced product. However, its two-wheel-roller approach feels crude when compared with the smooth action of roller ball mice, and the squarish shape of the mouse seems unnatural after using a more rounded design.—**Mitt Jones**

MICROSOFT CORP.

PC MAGAZINE FACT FILE

Microsoft Mouse, Bus Version
Microsoft Corp.
16011 NE 36th Way
Redmond, WA 98073-9717
(206) 882-8088
List Price: $175, including *Show Partner* and *Paintbrush* software.
Requires: 12K RAM, half-slot, DOS 2.0 or later.
In Short: The industry standard, the two-button Microsoft Mouse is supported by a wide variety of software. It is also especially well designed ergonomically to fit neatly into the palm of your hand.
CIRCLE 638 ON READER SERVICE CARD

Microsoft Mouse, Serial Version
Microsoft Corp.
16011 NE 36th Way
Redmond, WA 98073-9717
(206) 882-8088
List Price: $195, including *Show Partner* and *Paintbrush* software.
Requires: 12K RAM, serial port, DOS 2.0 or later.
In Short: The serial version of the two-button bus mouse that is also reviewed here, this mouse is an industry standard. It is supported by a wide variety of software. It also comfortably fits into the palm of your hand.
CIRCLE 637 ON READER SERVICE CARD

The Microsoft Mouse is the industry leader—and the most emulated of all mice—for some very simple reasons. It's a well-designed, well-constructed product that works. It is also supported by arguably the largest body of immediately compatible or easily adapted software. Because of this support, Microsoft and its two-button design will likely remain the de facto standard against which other mice must be measured.

The Microsoft Mouse comes in both bus and serial versions. The bus mouse costs $175; the serial is $195. Apart from the installation, these mice are identical. Like all bus mice, the bus version requires installation of a half-card in any available slot, while the serial mouse simply connects to an RS-232 port. The installation procedures are well thought out and easy to follow.

The software installation routine, however, is broken down into a series of simple steps, most of which require only one or two keystrokes from the user. While the introductory tutorial is useful only for novices, tutorials for individual applications are more in-depth.

The Microsoft mice come with preconfigured menus for *1-2-3*, Releases 1A and 2, *DisplayWrite 3*, and *MultiMate*, Version 3.31, allowing you to control cursor movement and pop-open menus within those applications.

When you use the mouse with *1-2-3*, for instance, a click of the left button pops up a screen options menu on the right side of the worksheet. This menu gives the mouse access to a number of keystroke commands. With the menu active, you can use the mouse to move the *1-2-3* highlight bar to the desired cell by clicking the left button. But when the screen options menu is deactivated, moving the mouse on the desktop will let you move the highlighted bar. A click of the right button brings up the *1-2-3* main menu.

One irksome omission is that the mice do not come with a menu generator for unsupported applications. Microsoft will send a programmer's reference on request, but a menuing system should be standard equipment.

In addition to its drivers, the mouse comes bundled with several software packages. *Paintbrush* is a freehand paint program that allows on-screen drawing and includes graphics primitives, such as circles, squares, and rectangles. It also includes the original version of *Show Partner*, an excellent presentation graphics package with extensive animation capabilities. These go a long way toward justifying the mouse's higher-than-average price.

The design of these mice is well thought out ergonomically. When you place your fingers on the buttons, the rounded body of the device—more literally mouselike than most others—fits neatly into the palm of your hand. The resulting support is very important during extended use, preventing hand cramps. And if you

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CIRCLE 205 ON READER SERVICE CARD

keep your CPU on the floor, you'll appreciate the mice's five-foot-long cord.

These mice use the traditional trackball design, which translates ball movement into on-screen cursor response and allows the mouse to move smoothly along a desktop. The downside of this design, however, is that whenever you pick up the mouse, the trackball rattles around in its socket, causing the cursor to jump about half an inch.

With many mice sprouting a third button, Microsoft's two-button rodent may seem a tad outdated. It's still a product to be reckoned with, though. If you don't believe that, take a quick survey of mouse emulations provided by the competition.—**Jonathan Matzkin**

MOUSE SYSTEMS CORP.

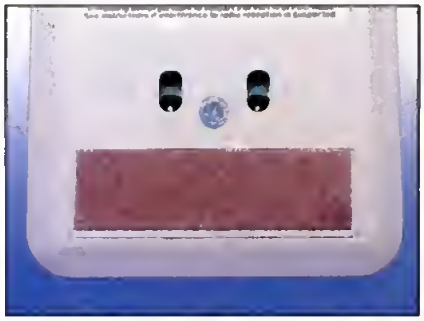
PC Mouse
PC Mouse Bus Plus

The $159 PC Mouse and the $179 PC Mouse Bus Plus, from Mouse Systems Corp., are far and away two of the smoothest mice ever to have scurried into my office. They are three-button optical mice and operate on a sturdy 7¾- by 9-inch pad. The installation software comes with a number of drivers that let you use the mouse with many popular software packages that don't offer their own mouse drivers.

The PC Mouse (which is the same product as the IMSI OptiMouse, also reviewed here) plugs directly into a serial port and draws its power from the port, eliminating the need for additional power cables. The Bus Plus version comes with an easy-to-install half-slot expansion card that can use COM1 or COM2, or, if used in a PC AT, a parallel interface, thus conserving your serial ports for other devices. Mouse Systems includes a setup file that makes installing the Bus Plus simple.

Once installed, both mice operate identically. They glide effortlessly over the fortified plastic-over-metal pad. The mouse coasts on felt, minimizing friction, and two LEDs on the bottom provide extremely accurate tracking.

Although many software packages still don't include their own mouse drivers, you'll be able to use your favorite software with these mice. Mouse Systems has included pop-up menus and drivers for 22 popular programs, including *dBASE II* and *III*, *WordStar*, *WordPerfect*, and *Paradox*. The PC Mouse also emulates the Microsoft Mouse for use with packages that support that mouse. I tested the mice with *1-2-3*, *Microsoft Word*, *Windows*, and *PC Paint*, and they performed flawlessly.



The PC Mouse (which comes in serial and bus versions) is an optical mouse that operates on a 7¾- by 9-inch pad. Two LED sensors on the bottom of the mouse record its movement over etched lines on the pad. The mouse coasts on felt, minimizing friction.

Photograph: Roberto Brusan

PC MAGAZINE FACT FILE

PC Mouse
Mouse Systems Corp.
2600 San Tomas Expwy.
Santa Clara, CA 95051
(408) 988-0211
List Price: $159
Requires: 64K RAM, serial port, DOS 2.0 or later.
In Short: A smooth three-button optical mouse, the PC Mouse is easy to install, and the software includes drivers and menus for many popular programs. (The same product as the IMSI OptiMouse.)
CIRCLE 636 ON READER SERVICE CARD

PC Mouse Bus Plus
Mouse Systems Corp.
2600 San Tomas Expwy.
Santa Clara, CA 95051
(408) 988-0211
List Price: $179
Requires: 64K RAM, half-slot, DOS 2.0 or later.
In Short: The three-button PC Mouse Bus Plus is simple to install. The software that comes with the mouse also includes drivers and menus for many popular programs.
CIRCLE 635 ON READER SERVICE CARD

The mice even come with a generic menu that allows you to use the mouse with the ten function keys, for programs that aren't configured for the mouse or that don't include mouse drivers.

The only drawbacks I can think of are the mice's 5-foot cord length and the need for desk space upon which to place the optical pad. With more computers being placed on floor stands, Mouse Systems may want to lengthen the cord, an easy fix. Other than that, the PC Mouse and the PC Mouse Bus Plus are close to perfect. So, if you are looking for a mouse that is easy to install, operates with practically any software, and gives smooth and seamless performance, spend your money here.
—**Christopher Barr**

SUMMAGRAPHICS CORP.

SummaMouse

Summagraphics Corp.'s $119 SummaMouse comes with the advantages and liabilities of optical technology. Instead of wheels or a trackball, it uses optical sensors—eyes, if you will—to detect movement. That's good, because the mouse has no moving parts to wear out or clog. It's also bad, though, because optical mice require a special reflective grid to move around on. The mouse "sees" the lines printed on the grid and translates movement on the pad into movement on the screen. While movement around the pad has a smooth feel, the pad takes up 9 by 11 inches of space next to your computer.

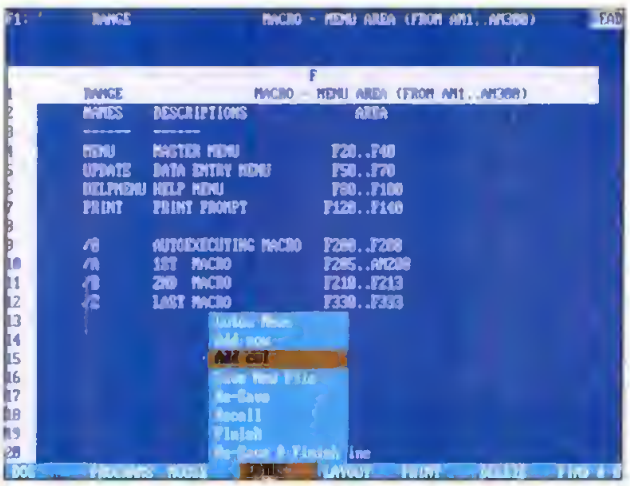
The SummaMouse requires a power supply that plugs into an AC outlet, so you must deal with a second cord in addition to the mouse's 4-foot-11-inch interface cord, which plugs into a serial port.

The SummaMouse emulates the Mouse Systems and Microsoft mice. I successfully tested it with Rix's *EGAPaint*, *Microsoft Windows*, and Lotus's *Freelance* and *1-2-3*. Also, the SummaMouse software allows you to define your own menus or modify those that come standard.

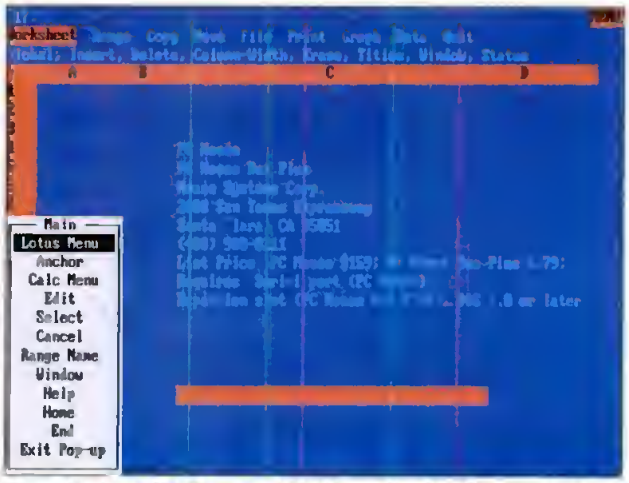
The software included with the SummaMouse stands out from the competition in some interesting ways. I booted the mouse from my AUTOEXEC.BAT file and was pleased to discover that Summagraphics includes a pull-down menu bar that is active in DOS. One of the menus

MENUS FOR MICE, PART 2

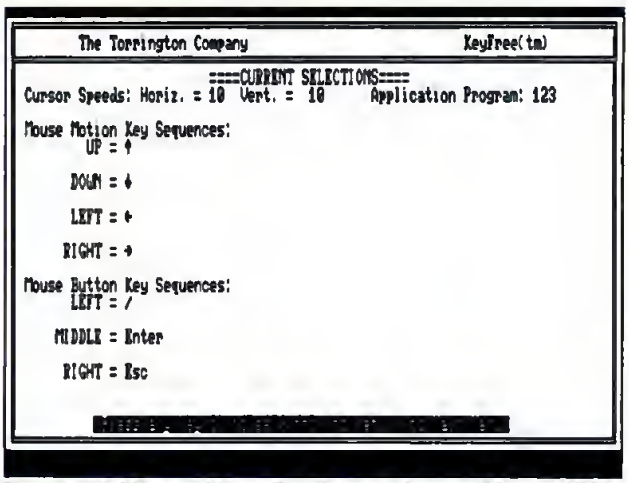
When you use the Microsoft Mouse (bus or serial version) with 1-2-3, *you can click the left button to pop up a screen options menu on the right side of the worksheet.*



The 1-2-3 *menu provided with the Summagraphics SummaMouse boasts a good selection of common spreadsheet options. It also has a choice that brings up the main* 1-2-3 *menu.*



Mouse Systems' PC Mouse and PC Mouse Bus Plus have pop-up menus and drivers for 22 popular programs. This software includes menus for 1-2-3, *shown here.*



Torrington's Manager Mouse Cordless and Manager Mouse 100IC-KF include KeyFree, *which has an impressive number of predefined interfaces and lets you create new drivers easily.*

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A credit firm that supplies information to banks employs Bernoulli Boxes to work with smaller banks and credit unions. Credit requests are controlled on individual cartridges, making it easy to keep track of information and disperse it to the appropriate users. This unique approach to database management uses cartridges as electronic file cabinets, combining the best of physical and electronic data management.

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A Big Eight accounting firm does extensive tax preparation and in-depth financial analysis, and maintains audit trails utilizing the Bernoulli Box. Its large 10- or 20-megabyte capacity provides adequate storage for such applications and security for each client. Instead of tying up the firm's mainframe system with heavy number crunching, accountants download client information and data onto Bernoulli Cartridges and develop the client analysis at individual PC workstations.

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PROGRAMMING:

One of the largest software developers in the U.S. uses Bernoulli Boxes to manage enormous amounts of software source code. Programmers record all the source code for an application on one cartridge, make backup cartridges for protection, and work directly from a "working" cartridge. This allows them to modify code or develop revisions on multiple cartridges, without fear of damaging the original source code, which is safely stored on the "backup" cartridge.

GRAPHICS:

An architect in Chicago uses over 40 Bernoulli Cartridges a year archiving lengthy architectural designs generated on a CAD system. Using a Bernoulli Box gives him unlimited storage capacity, plus the portability to take cartridges with him when he meets with clients and contractors (many of whom also use a Bernoulli Box). This fast growth is a powerful benefit of Bernoulli Technology,™ whether for CAD, graphics or desktop publishing.

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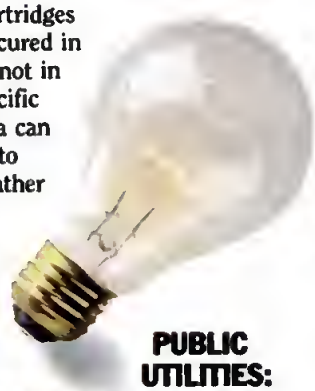

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A utility company in one Western city uses CAD software and Bernoulli Boxes to keep track of power and water lines. The company has divided the city into quadrants, storing the utility mapping for each quadrant on a single cartridge. Copies of cartridges can be quickly made to allow several people to work on different projects in the same quadrant at the same time. And cartridges can be easily archived for historical reference.

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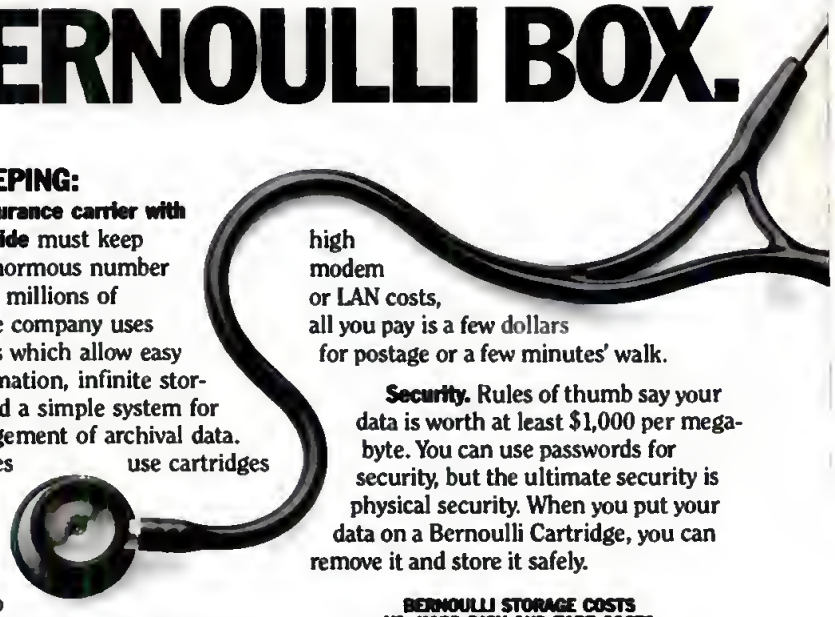

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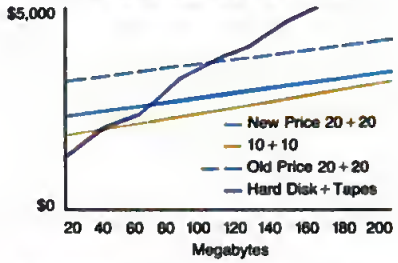

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From left to right are the Microsoft Mouse and Mouse Systems' PC Mouse, both available in serial or bus versions, the SummaMouse, and Torrington's Manager Mouse, which is available in cordless or serial versions.

PC MAGAZINE FACT FILE

SummaMouse
Summagraphics Corp.
777 Commerce Dr.
Fairfield, CT 06430
(203) 384-1344
List Price: $119
Requires: 256K RAM, serial port, DOS 2.0 or later.
In Short: This three-button optical mouse has powerful software support and works smoothly and well.
CIRCLE 634 ON READER SERVICE CARD

features several convenient choices for DOS housekeeping operations. A single click can copy files from one disk drive to another or take a directory.

Another pull-down menu allows access to several different popular applications, including *1-2-3* and *WordStar*. The *1-2-3* menu provided has a good selection of common spreadsheet operations. It also has a choice that brings up the main *1-2-3* menu, and another that gives you the freedom to exit to DOS with a single click. However, actual movement within the worksheet was not as pleasant; the highlight bar can be sent skittering well beyond its intended target with only a small movement of the mouse.

The documentation could have been better organized (for instance, the steps for hardware and software installation are separated by a number of pages) and was, in general, difficult to follow.

The SummaMouse has powerful software support and works well. Whether you will want it depends in large part on how you feel about optical mice.

—Jonathan Matzkin

THE TORRINGTON CO.

The Torrington Co.'s Manager Mouse eschews the rubber-coated roller ball design of most mechanical mice in favor of two plastic wheels—one for vertical pointer motion and the other for horizontal.

We tested two of the three available Manager Mouse models: the Cordless, which can operate up to 4 feet away from its light-sensing receiver, and the 1001C-KF, a serial mouse that runs on a 5-foot cord. The third model, the 1001C, differs from the 1001C-KF in price and comes with an additional paint program called *TelePaint*.

The Cordless transmits infrared light pulses to a small receiver you mount with Velcro on your CPU or desk. An AC adapter powers the receiver, and a rechargeable nickel cadmium battery runs the mouse for up to 10 hours of continuous use. A 40-inch recharging cord lets you use the mouse while it recharges.

To install the 1001C-KF serial mouse, you simply must plug the receiver's 25-pin connector into a serial port; Torrington also supplies a handy adapter to allow you to use a 9-pin port. You then plug the AC adapter into a jack leading from the serial connector.

I set up both mice to run on an IBM PC-XT, a Leading Edge Model D, and an AMT AT compatible. Running the Microsoft Mouse–compatible driver, both mice behaved perfectly with the applications I tested, including *Microsoft Word*. For

PC MAGAZINE FACT FILE

Manager Mouse Cordless
The Torrington Co.
59 Field St.
Torrington, CT 06790
(203) 482-9511
List Price: $229
Requires: 27K RAM, serial port, DOS 2.0 or later.
In Short: This three-button mouse has good software support and works smoothly.
CIRCLE 633 ON READER SERVICE CARD

Manager Mouse 1001C-KF
The Torrington Co.
59 Field St.
Torrington, CT 06790
(203) 482-9511
List Price: $179
Requires: 27K RAM, serial port, DOS 2.0 or later.
In Short: While this mouse is designed so that you'll never have to clean it, it doesn't have a smooth feel. It emulates the Microsoft Mouse and is hardware compatible with the Mouse Systems mouse.
CIRCLE 632 ON READER SERVICE CARD

Photograph: Roberto Brosan

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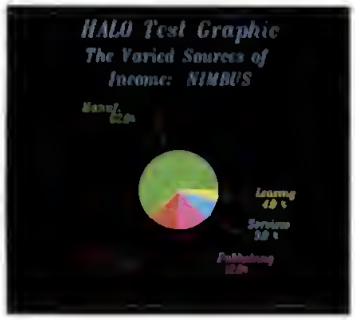
Since the introduction of the IBM PC class microcomputer, Media Cybernetics has been producing cost effective, high performance graphics and imaging software tools and solutions. These products have been consistently selected as organizational standards by government and military procurement officers and by corporate and educational buyers. The backbone of all Media Cybernetics' graphics and imaging software is the **HALO** Graphics Kernel System (HKS), the industry standard library of graphics subroutines. Over 140 Independent Software Vendors (ISVs) have used HALO to write programs such as CADKEY, Drafix II, and Artwork. These businesses selected HALO as their graphics development tool because of its performance, its support of over 100 devices and its practical licensing agreements.



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Media Cybernetics has also written its own popular HALO-based applications. **Dr. HALO II** is the most favorably reviewed graphics editing product available. It is icon-based and easy to learn and use. A freehand drawing package, it can be used to capture, edit and add text to images created in other programs. **Nimbus** is a menu-driven business graphics package which gives the user 12 easily modified graph styles and word charts. Nimbus users can make hard copy with plotters and printers or they can produce 4Kx4K resolution slides. **HALO DPE** is the first graphics-based desktop publishing editor. It is ideal for preparing newsletters, flyers and documents of ten pages or less. It is used as a graphics editing component of desktop publishing systems to give users superior drawing, scanning, scaling and editing functions. **Image-Pro** is an image processing program for the IBM AT which enables users to capture, edit and enhance images through advanced filtering techniques, contrast enhancement, histogram equalization, pseudo-coloring, etc. Image-Pro has brought minicomputer imaging power to the micro environment. Adopted by most major vendors of image processing hardware, Image-Pro is used in varied applications from medical imaging, satellite imaging, and photo interpretation, to graphic arts, security, and manufacturing.

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CIRCLE 218 ON READER SERVICE CARD

■ MICE

Torrington's Manager Mouse, in its cordless or serial version, has two plastic wheels—one detects vertical pointer motion, the other horizontal motion.

some applications, such as *Microsoft Windows*, you must choose the Mouse Systems driver.

All things considered, however, the Manager mice are only average. Torrington claims its two-wheel design eliminates dirt buildup inside the mice, thereby avoiding the occasional cleaning most mice require. However, the plastic wheels don't give you the smooth but sure feedback you get with a roller ball mouse; I'd rather clean my mouse every blue moon or so. I also prefer a more rounded shape over the Manager Mouse's boxlike design.

Admittedly, the novelty of the Cordless mouse makes life a little more fun . . . for a while. But who can remember to recharge their mouse every few days? You also have to make room for the AC adapter on your power strip and put up with more wires snaking around behind your system.

Both models we evaluated include *KeyFree*, which boasts an impressive number of predefined interfaces and lets you create new drivers easily. But neither the predefined interfaces nor the interfaces you can create pack much power.

For example, *KeyFree*'s *1-2-3* interface gives you only three button commands: the "hot key," Enter, and Escape. In comparison, Maynard Electronics' *CustomKey* gives you seven button-combination commands and a pop-up menu with 16 predefined macros.

The otherwise nicely done documentation lacks sections that detail the installation and use of the mice with specific software packages: a Torrington representative said that the company's Software Guide includes that information, but that the mouse package is too full to hold an additional pamphlet. Manager Mouse owners can obtain the Software Guide by calling Torrington.

Despite a few limitations, the Manager Mouse works well with a wide range of applications and on a wide range of computers. If you don't need sophisticated software, or if your phobias include a fear of cleaning mice, the Manager Mouse may prove to be a smart buy.—**Mitt Jones**

PC MAGAZINE EDITOR'S CHOICE

- **Logitech Bus Mouse**
- **Logitech Serial Mouse**

At $99 and $119, the Logitech Serial Monse and Bus Mouse are among the least expensive mice reviewed. Bnt despite their bargain-basement price, these mice support an impressive 24 programs. And if those 24 aren't enough, these nice come with an excellent menuing system that is powerful enough to let you program submenus and context-sensitive menus. These mice also have an exceptionally good "feel," moving smoothly across a desktop with just enough friction to allow for precise cursor control.

Though slightly more expensive, at $159 and $179, the PC Mouse and PC Mouse Bus Plus from Mouse Systems Corp. are also excellent buys. These mice are easy to install and to operate and offer pop-up menus and drivers for 22 popular programs. They also provide a generic menu for use with nonsupported applications.

Christopher Barr is the manager of the PC Magazine Interactive Reader Service. Bill Howard is an executive editor on the staff of PC Magazine. *Mitt Jones and Jonathan Matzkin are assistant editors on the staff of* PC Magazine.

Photograph: Roberto Brosan

WHAT MAKES THE ALPS SO SPECIAL, ANYWAY?

YOU CA
THE WHO

There's something for everyone in the ALPS.

Because the ALPS family of Dot Matrix Printers has everything it takes to handle any business need.

Need a printer that can take on a department full of PCs?

Then look at our P2000 Series. There's our top-of-the-line P2400C,™ which zips along at 360 cps, prints 7 colors and is jam packed with smart features. Our amazingly fast black-and-white P2100,™ with a cruising speed of 400 cps. And our P2000,™ voted one of

N TAKE
LE FAMILY.

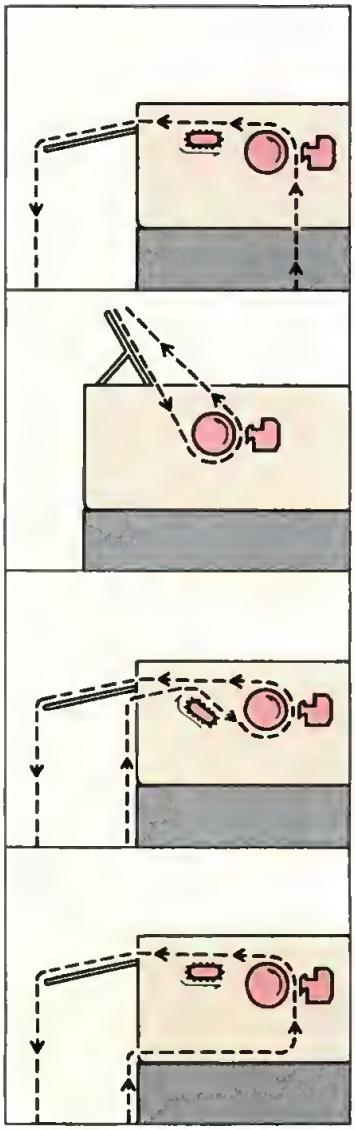
PC Magazine's "Best of 1986."

If you need something more personal, try our ALQ Series. Both the ALQ300™ and ALQ200™ print superb letter quality text and high resolution color graphics. And they do it quickly, easily and economically.

But whichever ALPS you choose, you'll find they all have something in common. Each is an exceptionally well thought out machine.

To see how, our tour continues on the next page.

THERE A POINTS OF

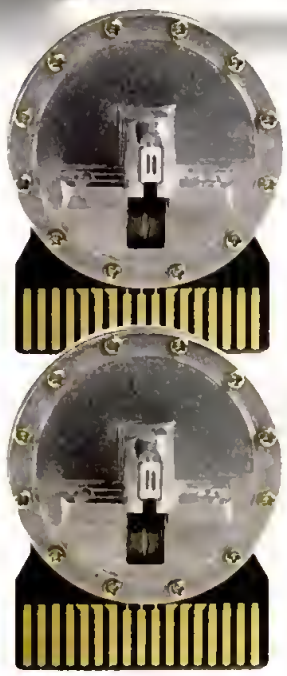


To handle any kind of paper, numerous feed methods are offered, including bottom feed...

automatic single sheet feed...

paper-saving push tractor feed...

and pull tractor feed.



Snap in/out, interchangeable 24- and 18-pin print heads ensure software compatibility and eliminate costly service calls.

Convenient multiple font cartridges bring real versatility to text printing.

Push-button front panel and special features menu both control printing functions without DIP switches.

No other printer company has thought to include so many useful features in their machines. Or bothered to make them so easy to use.

Of course, there are more ALPS attractions than the ones you see above.

Like a choice of print modes: draft, correspondence and letter quality. Plus an expandable print buffer that frees up your computer for other jobs while the ALPS is still printing.

And no matter how complicated

RE MANY INTEREST.

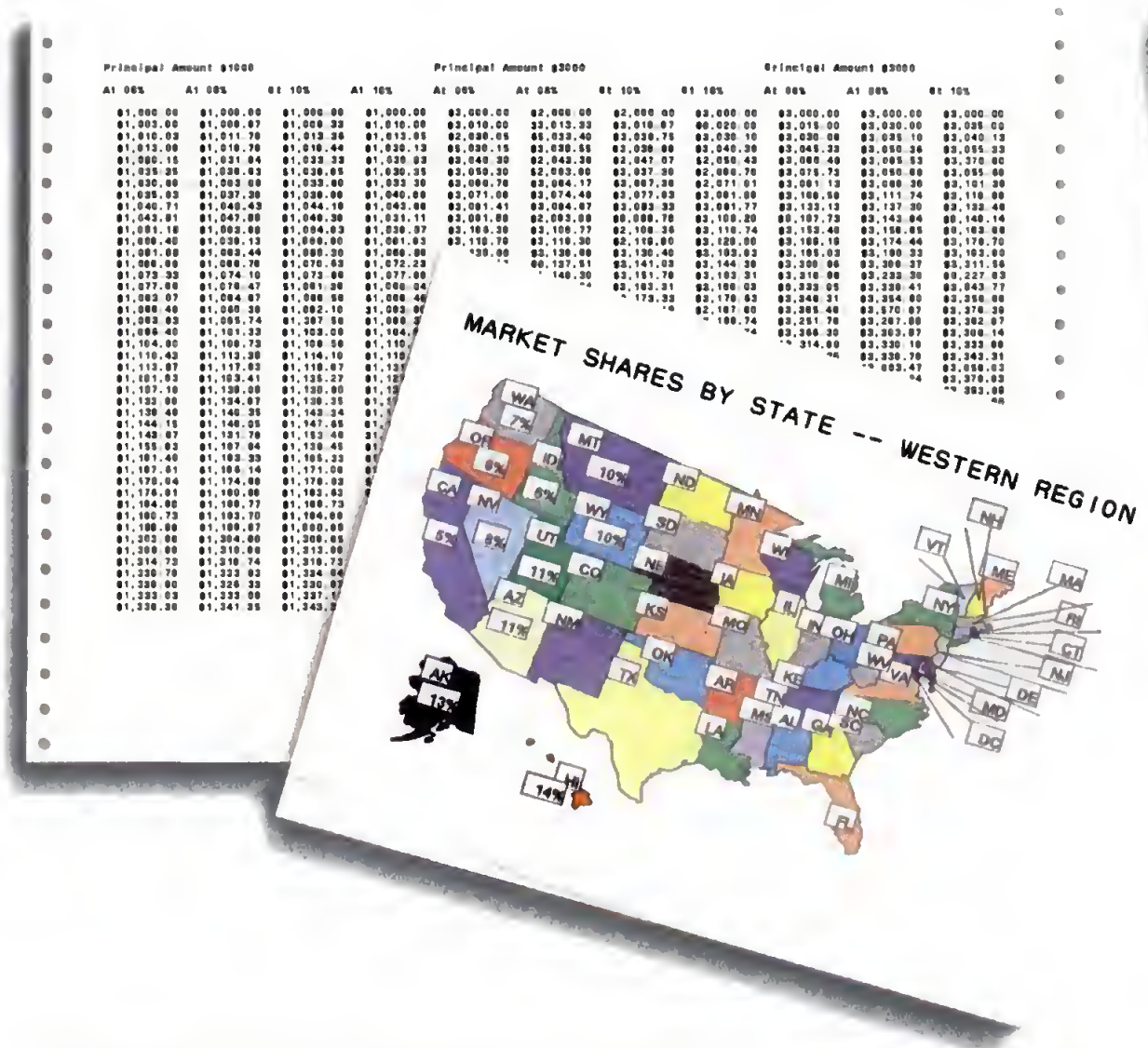
Long-lasting ribbons print crisp black and white or brilliant seven-color output.

the job may be, our control panel makes it simple. You just push a button to change type styles, feed paper, reprint data, or do most anything else.

As for compatibility, ALPS printers run with most all the leading PCs and software.

Best of all, they're especially compatible with the way you run your business.

THE ARE SPEC



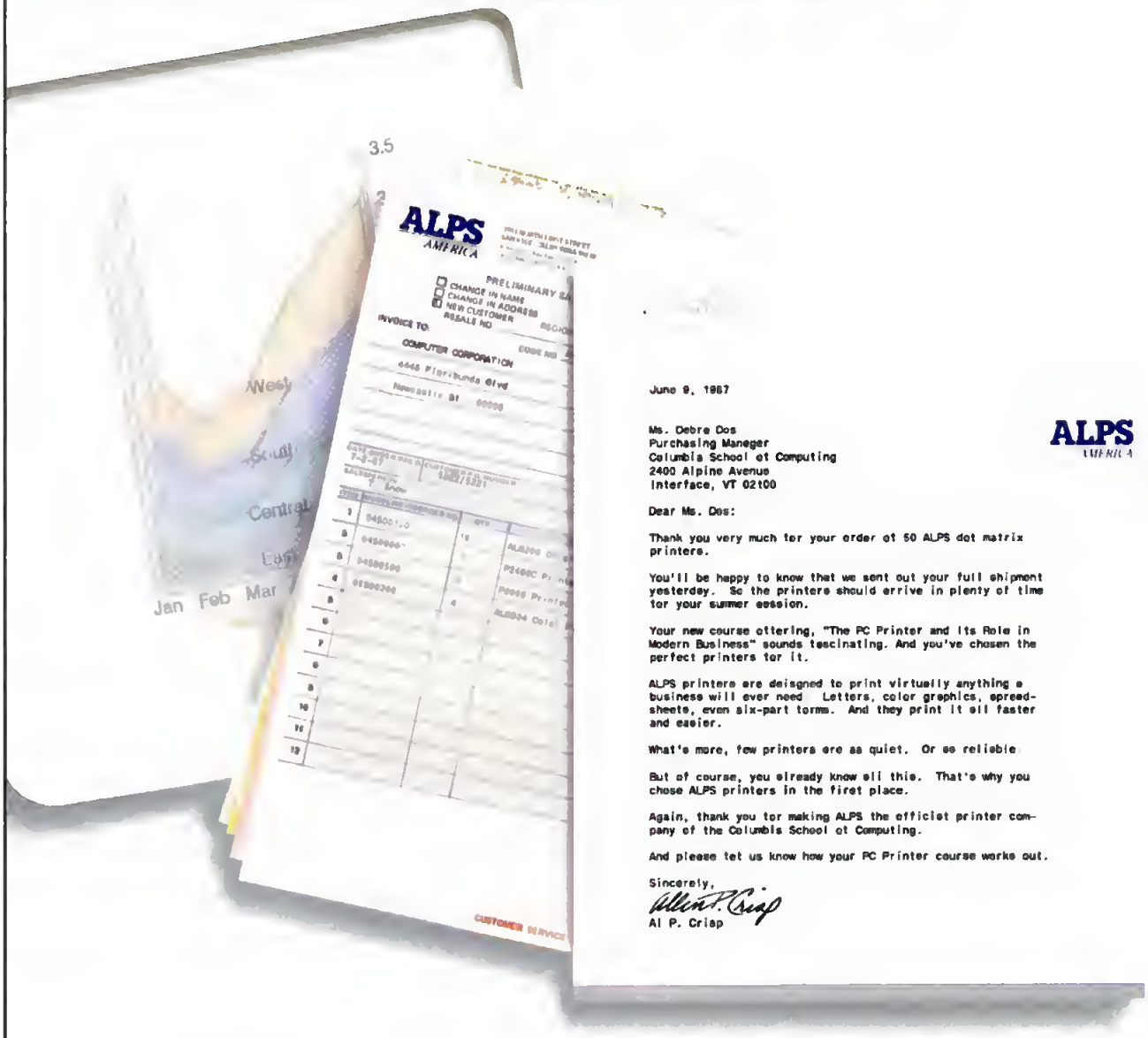
Here's something you probably won't see in any other printer ad.

Namely, everything from letter quality text and high resolution color graphics to transparencies, 16-inch-wide spreadsheets and six-part forms.

Fact is, most printers can't handle such a wide range of work. Then again, most aren't built like the ALPS.

Our printheads are precisely engineered to produce exquisite letter quality text. Yet they're rugged enough to churn out over 200 million characters. No matter how hard you work them.

VIEWS TACULAR.



And because the ALPS are compatible with all kinds of software, they can produce all kinds of images. Plus, if you haven't heard, they run at exceptionally quiet noise levels of under 55 dBA.

What's more, they'll run for what seems to be forever. They come with a full one-year limited warranty. And with normal care, they'll give you over five years of spectacular work. Without a speck of trouble.

Can any other printer make you look this good?

AND THE CR

"...the speed, print quality, and other thoughtful features of the ALPS P2000...make this wide-carriage 9-pin matrix printer my favorite new printer of the year."

—PC Magazine

"The ALPS ALQ300 and P2400C are both rugged wide-carriage dot matrix printers with excellent letter quality type..."

—PC Magazine

"ALPS America keeps on coming back with more attention-getting dot matrix printers."

—PC Magazine

"To distinguish letter-quality from daisywheel output requires a magnifying glass."

—PC Week

As you can see, our printers even have the best ink.

But if you're the type who's not easily swayed by popular opinion, consider this:

Since our first printers were introduced in the U.S. in late 1985, ALPS America has become one of the fastest growing printer companies in the country.

Which should come as no surprise. After all, ALPS printers are built

ITICS AGREE.

"...so quiet that we doubt even a library would need the 'quiet' mode."

—*InfoWorld*

"...its controls are the most accessible of any printer we have used..."

InfoWorld

"In almost every phase of construction, ALPS seems to have relied on sturdier materials than it might have had to—something which is a definite advantage for the user."

—*PC Products*

"...a real workhorse printer that prints faster than others in its price range and is loaded with features..."

—*PC Products*

by ALPS Electric, a $2.0 billion, International Fortune 500 company that's been successfully manufacturing and marketing computer printers worldwide for over a decade.

And doing so by following a very simple idea.

To bring you the most intelligent, versatile and reliable business printers on the market.

At prices you can't help but agree with.

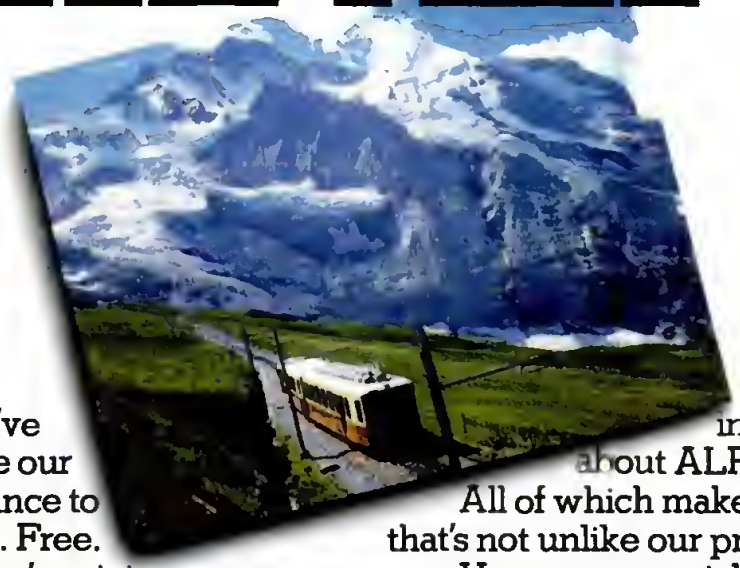
SO HERE'S Y
TO TH

MACHINE	PRINT METHOD	PRINT MODE/SPEED
P2000	9-pin serial dot matrix. Black and white.	Draft 250cps Correspondence 125cps Letter quality 50cps
P2100	18-pin serial dot matrix. Black and white.	Draft 400cps Correspondence 200cps Letter quality 80cps
P2400C	18- or 24-pin serial dot matrix. Color and black and white.	24-pin 18-pi Draft 360cps 250c Correspondence 180cps Letter quality 120cps 125c
ALQ200	18- or 24-pin serial dot matrix. Color and black and white.	24-pin 18-pi Draft 240cps 200c Correspondence 120cps Letter quality 80cps 100c
ALQ300	18- or 24-pin serial dot matrix. Color and black and white.	24-pin 18-pi Draft 240cps 200c Correspondence 120cps Letter quality 80cps 100c

OUR GUIDE E ALPS.

INTERFACE	PAPER FEED	BUFFER	EMULATIONS	SIZE	SPECIAL FEATURES
Centronics parallel and RS-232C serial ports standard.	Push/pull tractor, bottom and rear feed, automatic single sheet loading standard. Single bin sheet feeder optional.	4KB standard, expandable to 260KB.	Epson FX and MX Series	Width: 24.4" Depth: 16.5" Height: 5.5" Weight: 33 lbs. Carriage width: 16.5" 136 columns at 10 pitch. 272 columns at 20 pitch.	Two font cartridge slots. Automatic copy feature. Quiet, below 55dBA operation. Excellent multi-part forms capability. 1-year warranty
Centronics parallel and RS-232C serial ports standard.	Push/pull tractor, bottom and rear feed, automatic single sheet loading standard. Single bin sheet feeder optional.	4KB standard, expandable to 260KB.	Epson FX and MX Series, DEC.	Width: 24.4" Depth: 16.5" Height: 5.5" Weight: 37.9 lbs. Carriage width: 16.5" 136 columns at 10 pitch. 272 columns at 20 pitch.	Two font cartridge slots. Automatic copy feature. Quiet, below 55dBA operation. Excellent multi-part forms capability. 1-year warranty.
Centronics parallel and RS-232C serial ports standard.	Push/pull tractor, bottom and rear feed, single sheet automatic paper loading standard. Single and dual bin sheet feeder optional.	4KB standard, socketed for easy expansion to 260KB.	Epson LQ, FX, JX, EX and MX Series.	Width: 25.4" Depth: 17.7" Height: 7.09" Weight: 43.7 lbs. Carriage width: 16.5" 136 columns at 10 pitch. 272 columns at 20 pitch.	Two font cartridge slots. Snap in/out print head. Special printing features selected via menu, control panel or software. Quiet, below 55dBA operation. 1-year warranty.
Centronics parallel port standard, RS-232C serial port optional.	Fan-fold bottom and rear feed, single sheet automatic paper loading standard. Bi-directional tractor, single and dual bin feeder optional.	7KB standard, expandable via plug-in buffer cartridge to 71KB.	Epson LQ, FX, JX, EX and MX Series.	Width: 18.5" Depth: 15.8" Height: 5.6" Weight: 30.9 lbs. Carriage width: 11.5" 80 columns at 10 pitch. 160 columns at 20 pitch.	One font cartridge slot. Snap in/out print head. Special printing features selected via menu, control panel or software. Quiet, below 55dBA operation. 1-year warranty.
Centronics parallel port standard, RS-232C serial port optional.	Fan-fold bottom and rear feed, single sheet automatic paper loading standard. Bi-directional tractor, single and dual bin feeder optional.	7KB standard, expandable via plug-in buffer cartridge to 71KB.	Epson LQ, FX, JX, EX and MX Series.	Width: 24.1" Depth: 15.8" Height: 5.6" Weight: 37.5 lbs. Carriage width: 16.5" 136 columns at 10 pitch. 272 columns at 20 pitch.	One font cartridge slot. Snap in/out print head. Special printing features selected via menu, control panel or software. Quiet, below 55dBA operation. 1-year warranty.

NOW SEE THE ALPS AND WIN THE ALPS.



Now that you've had a chance to see our ALPS, here's a chance to see the other Alps. Free.

Once again, we're giving away a 10-day trip for two to the Swiss or Japanese Alps. With expenses paid, including airfare, hotel and meals.

To enter, just send in the attached coupon. Or call or write us at the address shown below.

We'll then include your name in our vacation drawing. And, if you wish, we'll arrange a free demo at your convenience. Or send you more information about ALPS printers.

All of which makes for an offer that's not unlike our printers.

Very, very special.

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AMERICA

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TABLETS
FOR PRECISION GRAPHICS

PC graphics tablets electronically re-create the traditional working environment of the drafter and the designer. Hence many drafters and designers find using a PC graphics tablet more to their liking than using a mouse or some other input device.

Most graphics tablets consist of a flat drawing surface, analogous to the drafting table or drawing pad. And they use some kind of pointing device, analogous to a drafting pen or drawing pencil, that translates analog motion (the movement of your hand) into digitized data that the software can then use.

While a few PC graphics tablets have unique applications and can be used for text or data input as well as for paint and drawing programs, most remain dedicated to their original purpose: CAD applications. Despite the popularity of mice and their sheer ubiquity, many users of dedicated CAD systems prefer graphics tablets for drawing or tracing. In general, most graphics tablets offer better resolution than most mechanical mice, averaging 200 units per inch. And, in fact, graphics tablets were an institution long before the mouse entered the PC arena.

This article looks at seven PC graphics tablets ranging from $163 to $1,495: the GTCO Digi-Pad Type 5A Model 1111A, the Koala Technologies KoalaPad+ Touch Tablet, the Kurta IS/ONE Series Tablet, the Pencept Penpad Model 320, the Science Accessories GP-7 Grafbar Mark II Sonic Digitizer, the Summagraphics SummaSketch 1201, and the Versa Computing VersaWriter.

DIGITIZING MOTION Most graphics tablets are small enough to fit on a desktop, but others are as large as a standard drafting table and can measure 5 feet by 3 feet.

Reminiscent of drafting tables, drawing pads, pens, and pencils, PC graphics tablets offer designers and draftsmen a comforting familiarity while serving as a tool for accurate input.

Whatever their size, graphics tablets use a number of different methods to digitize motion.

The most common digitizing method is called the antenna-transmitter technique. Other digitizing methods use sonic-pulse transmission and the potentiometer technique. In the antenna-transmitter method, the drawing surface, which is the antenna, has a grid of fine wires whose intersections are represented by *x-y* coordinates. When you use a pointing device—a pen, stylus, or cursor—it transmits a signal to the antenna. The antenna in turn sends the signal to the driver software, which translates it into cursor motion.

The sonic-pulse method does not require that a graphics tablet act as an antenna. Instead, the stylus transmits a sonic pulse that the digitizer hardware receives. The GP-7 Grafbar Mark II Sonic Digitizer uses this method. The benefit is that when you use a sonic digitizer like the GP-7 Grafbar Mark II, your drawing surface is not restricted to the somewhat arbitrary limits of a tablet.

The VersaWriter is unique in that it uses neither the antenna-transmitter method nor the sonic pulse. An arm mounted on the drawing surface contains one potentiometer, while a joint connected to another arm contains another potentiometer. Moving the two arms generates signals from the two potentiometers, which give the *x-y* coordinate positions. Most joysticks use this technique as well; in fact, despite their association with games, most joysticks are workable drawing tools.

POINT AND STREAM MODES Some graphics tablets offer more than one mode of transmitting *x-y* coordinates. The point mode lets you draw lines by setting start and end points, which correspond to vector-based CAD applications. The stream mode sends a continuous signal, used primarily for drawing freehand or tracing curves.

Most of the products reviewed here use a cord to connect the pointer, which generates the *x-y* coordinates sent to the tablets that receive them, and to supply power to the transmitter. However, the Kurta IS/ONE Series Tablet has an option for a cordless pointer, which can be either a stylus or cursor. The power for the transmitter is contained in an on-board battery. An ingenious contact-sensitive switch ensures that when the pointer is not being held, power is not consumed.

POINTING DEVICES Graphics tablets generally use one of three typical pointing devices: a pen, stylus, or cursor (also called a puck). Most use either a pen or a stylus. The terms pen and stylus are sometimes used interchangeably; both pointing devices are shaped like a pen and are connected to the tablet by a thin cable. But they are slightly different.

The pen actually contains a ballpoint cartridge and ink, so that you can see what you've drawn. You use the pen to make new drawings, sketch freehand, and so on.

■ Casual users of CAD software may not be able to justify the cost of a graphics tablet, but if you make your living drawing, you can scarcely afford not to own one.

A stylus is simply a blunt point that does not deposit ink on the drawing. You use it primarily for tracing existing drawings or as a pointing device.

Most CAD users prefer to use a cursor, which resembles a mouse in shape but has some important differences. A cursor usually has a lens or reticle, which has fine wire cross hairs and contains the transmitter. You trace drawings by guiding the cross hairs over the lines; that in turn sends a signal to the computer.

A cursor also has several buttons that can double as function keys for a given application. Some cursors have up to 16 buttons; they let you do most CAD functions without touching the keyboard.

Some CAD users work with a light pen along with a graphics tablet that functions with a pen, stylus, or cursor: certain CAD software lets you create drawings on the tablet or trace them from existing drawings while making corrections on the screen with the light pen.

PORTS AND DRIVERS Graphics tablets for the PC generally use a serial port for input, although the KoalaPad+ Touch Tablet and the VersaWriter use the game port. Only one pad reviewed here, the Pencept Penpad, requires its own interface card.

Using a proprietary card confers some advantages, in part because the card can buffer input. A serial device may have to dump data in bursts because it takes a certain amount of time to process an *x-y* coordinate pair on the tablet.

Pencept's Penpad is the only graphics tablet that has a viable mouse driver as part of the software package. The Penpad mouse driver, which is compatible with the Microsoft Mouse, makes it possible to use the Penpad as a mouse substitute or as a replacement for applications other than CAD or paint software. The KoalaPad+ includes a mouse driver, but it does not work with other software.

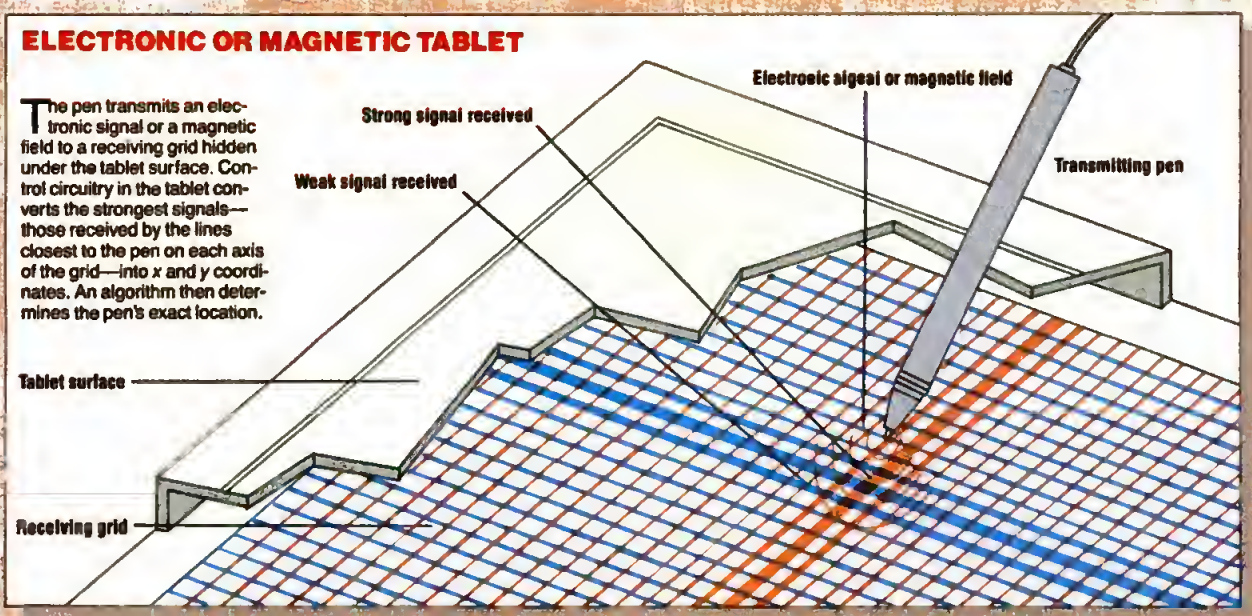
The Kurta IS/ONE line and the Summagraphics SummaSketch, on the other hand, have a great deal of software support and a long-standing following in the graphics market. Most of the popular graphics packages, such as *AutoCAD*, *VersaCAD*, *Dr. Halo*, and *Halo DPE*, come with the drivers to support these devices. And while the IS/ONE line is new, most of the applications with drivers to support the previous models—the Kurta Series One, Two, or Three tablets—will support the new pad. Not only do these tablets work with a wide range of software, but they also come with acetate templates for some that neatly lay out the program's menu on the tablet surface. With a program such as *AutoCAD* that is deep with functions, using such a template eliminates confusion.

The KoalaPad+ and the VersaWriter are locked into a world of their own: both use their own proprietary software and are not really graphics tablets in the most traditional sense. These devices have pretty much stayed the same since we reviewed them 3 years ago (*PC Magazine*, Volume 3 Number 12). Optical mice and a host of

How a Tablet Works

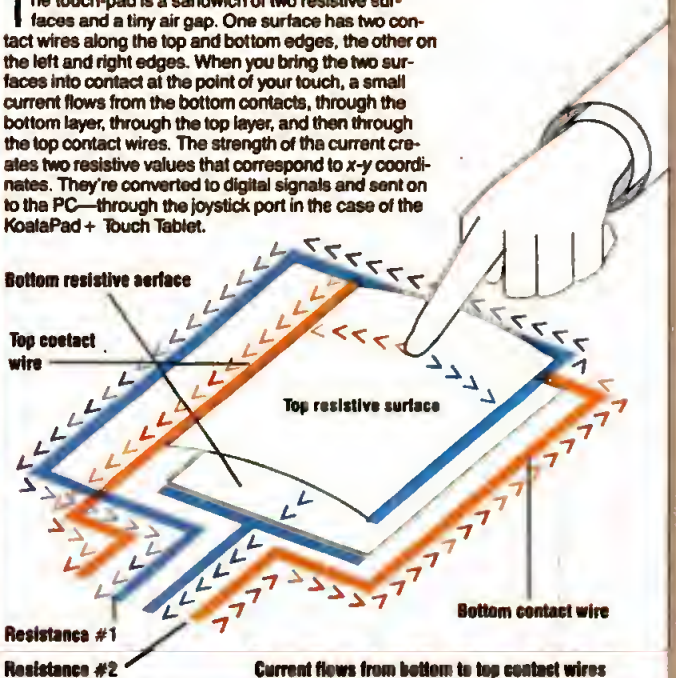
ELECTRONIC OR MAGNETIC TABLET

The pen transmits an electronic signal or a magnetic field to a receiving grid hidden under the tablet surface. Control circuitry in the tablet converts the strongest signals—those received by the lines closest to the pen on each axis of the grid—into *x* and *y* coordinates. An algorithm then determines the pen's exact location.



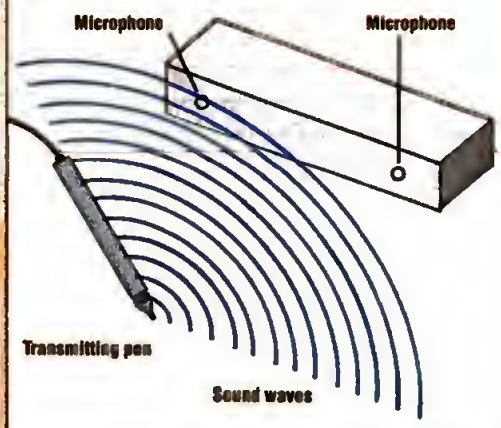
RESISTIVE TOUCH-PAD

The touch-pad is a sandwich of two resistive surfaces and a tiny air gap. One surface has two contact wires along the top and bottom edges, the other on the left and right edges. When you bring the two surfaces into contact at the point of your touch, a small current flows from the bottom contacts, through the bottom layer, through the top layer, and then through the top contact wires. The strength of the current creates two resistive values that correspond to *x-y* coordinates. They're converted to digital signals and sent on to the PC—through the joystick port in the case of the KoalaPad + Touch Tablet.



ACOUSTIC TABLET

The pen transmits high-frequency sound waves that are received by microphones at the corners of the work area. The strength of the signal received at each microphone is measured to indicate the pen's distance from that microphone, and triangulation is used with the two distance measurements to determine the pen's position.



Still thi

40 MB. In a 1" card. We told our engineers it couldn't be done. That everybody else uses a 2" card. Or an add-in drive the size of a breadbox.

Of course, they had a few words on the subject: "No pain, no gain."

Even with 40 MB, Hardcard 40 still fits in a single slot in your COMPAQ Portable II, PC, XT, AT, PS/2 Model 30 or compatible. Compare that to conventional hard disks, like the one at the right, which take up four times the space. Use far more power. Take hours to install. And are only half as reliable.

And this is what happens when you let a bunch of fanatics have their way.

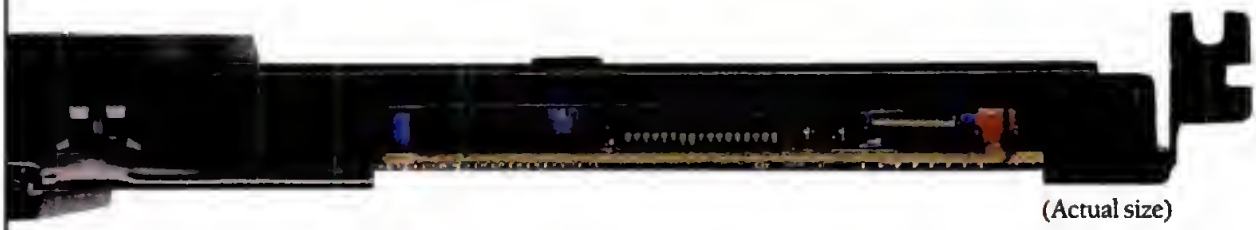
Hardcard™ 40. It's still only 1" thick. So it fits in a single slot. And leaves the other slots wide open for anything you like.

If you've got a COMPAQ® Portable II, you can give it twice the storage. And 40% faster access time. If you own a PC, XT, or AT compatible, you can keep the existing hard disk, add Hardcard 40, and build your total storage to 50-70 MB. All with AT-fast response time.

It's even compatible with the new IBM® Personal System/2,™ Model 30. In both configurations.

As you might expect, Hardcard 40 is engineered lean and tight. With no compromises. So it needs a lot less power than overweight drives. And can take 100G impact. All of which gives us two to four

n at 40.



(Actual size)

times more reliability than other disk drives.

Plus Hardcard. Now you can choose 20 or 40 MB versions. And stuff a ton of data in your PC. Without adding an inch of fat.

Just see your local computer dealer for a demonstration.

Or call (800) 826-8022 for the dealer nearest you.

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CIRCLE 499 ON READER SERVICE CARD

other graphics software have surpassed them.

CAD PROS Most of the CAD users I've talked to prefer graphics tablets over mice, probably in part because graphics tablets give them a reassuring sense of traditional working techniques while affording reliable, accurate input.

Casual users of CAD software may not be able to justify the cost of a graphics tablet, but if you make your living drawing, you can scarcely afford not to own one.
—Tom Stanton

GTCO CORP.

Digi-Pad Type 5A Model 1111A

The Digi-Pad Type 5A Model 1111A, from GTCO Corp., is a compact and powerful digitizing machine that sells for $995 for the stylus model and $1,265 for the 16-button cursor model. While setting it up requires a bit of work, you can cut loose once it's installed.

The Digi-Pad Type 5A Model 1111A relies on electromagnetic fields to locate the position of the stylus or the cursor. Its 11- by 11-inch workspace is set inside a slightly larger square of white plastic, which is mounted in a beige housing. The entire surface is raised at a gentle angle, similar to that of a PC keyboard, for comfortable use on a level surface.

The pad itself has no raised edges, so working with designs on paper larger than its surface is only minimally inconvenient. And its electromagnetic design means that thick originals do not pose any problems for the user.

GTCO's Digi-Pad Type 5A Model 1111A uses electromagnetic fields to locate the position of the stylus or cursor. Because of the electromagnetic design, thick originals pose no problems.

SETUP Hooking up the Digi-Pad is straightforward, since there are relatively few connections. A separate power supply plugs in between the wall and the pad, and the pointer device attaches to a standard 15-pin D-connector in the pad.

To connect to the PC, the Digi-Pad also has two 25-pin serial ports, one configured as a DTE device, and the other as a DCE device. Basically, the difference between the two is that one expects a cable with the pins connected straight through (as to a modem), and the other wants certain connections crossed (as in a null-modem cable used to connect to another computer). What's important is that you will probably be able to get the unit to work with a serial cable that you already have on hand.

The Digi-Pad manual shows how you can use these ports for complex installations, since the unit can pass information from one port to the other. You could hook the pad to a computer and a terminal to the pad, and then use the terminal to send commands to both the pad and the computer while displaying information sent by the computer.

You use three banks of DIP switches, eight per bank, to set up the pad for your application. The documentation lists the switch settings you'll need to set for *AutoCAD*, but you're on your own for other programs, since the manual contains mostly technical details and little in the way of helpful applications notes. Given the Digi-Pad's extraordinary flexibility, the task can be daunting.

Besides the myriad settings for the serial connections, you can also select different operating modes, measurement scales, and formats for the coordinate data.

The pad has an audible alarm system that emits a series of different tones in different patterns to tell you the status of the pad. For example, the pad gives four short, high beeps during power on to indicate that it has passed the self-test. A single, steady tone sounds when the pointing device is outside the active area.

The Digi-Pad emits 15 signals in all, but you can silence half of them just by set-

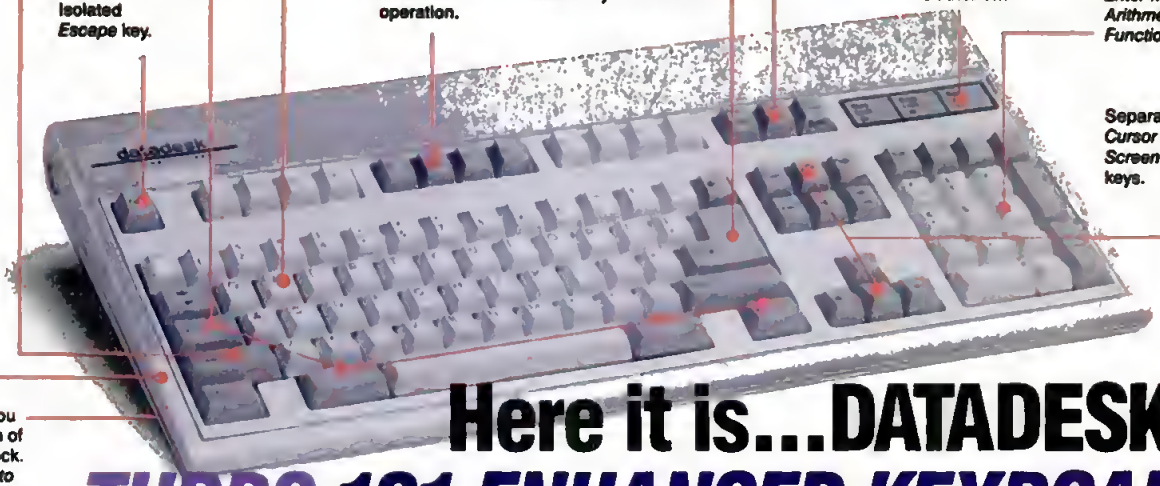
PC MAGAZINE FACT FILE

Digi-Pad Type 5A Model 1111A
GTCO Corp.
7125 Riverwood Dr.
Columbia, MD 21046
(301) 381-6688
List Price: $995 (with stylus); $1,265 (with 16-button cursor); $150 for power supply.
Requires: Serial port.
In Short: A digitizing pad with flexible interfacing options and a smooth, electromagnetic locating design.

CIRCLE 628 ON READER SERVICE CARD

Photographs: Roberto Brosan

Borland's Turbo Lightning FREE



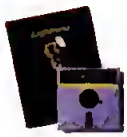
Here it is...DATADESK'S *TURBO-101 ENHANCED KEYBOARD*

for the 10 million PC users IBM just ignored!

IBM just ennounced their new redesigned "standard" keyboard for personal computers. There's only one problem: *it won't work* on your IBM computer if it wes purchased prior to June 1988 or on *any* PC compatible purchased et eny time!

Not to worry. Our new *Turbo-101* Enhenced Keyboerd gives you the layout and enhancements of the IBM with some logicel improvements (see ebove photo). And it works on your existing PC, XT, AT, PCjr, AT&T, Epson end virtuelly ell compatibles!

Get Borland's Turbo Lightning ™ For FREE!



To reelly turbocharge your productivity, we are including, free-of-charge, Borlend's red-hot Turbo Lightning software with each keyboard. Now, when using SideKick, WordPerfect, Microsoft Word, 1-2-3 or most popular progrems, our Turbo-101 Keyboard will check your spelling *as you type*, gives you instant eccess to Random House's 80,000-word Concise Dictionary and 60,000-word Theseurus and much, much more!

"Lightning's good enough to make programmers und users cheer, executives of other software companies weep," says Jim Seymour of PC Week. Sold separately, Turbo Lightning retails for $99.95!

The Turbo-101 is the best data entry tool since the pencil!

For users of spreedsheets like 1-2-3, the Turbo-101's *separate* cursor controls and numeric keypad makes entering numeric deta into cells end moving from cell to cell as natural as moving your fingers. And for *word-processing*, the *'Selectric'* typewriter leyout mekes the Turbo-101 es eesy to use es a pencil; end with the extre lerge Enter, Shift & Control Keys, you'll meke so few mistakes, you won't even need an ereser!

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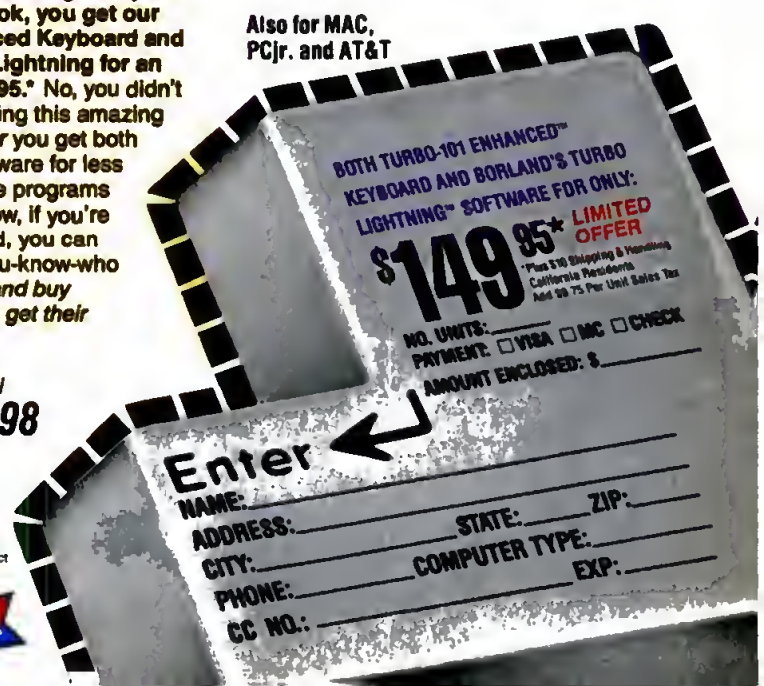

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Tablets: Summary of Features

(Products listed in ascending price order)

	KoalaPad + Touch Tablet	VerseWriter	SummaSketch 1201	IS/ONE Series Tablet	Digi-Pad Type 5A Model 1111A	GP-7 Grafbar Mark II Sonic Digitizer	Pencept Penpad Model 320
List price	$163	$299	$599	$895 (with corded pen or corded puck) $995 (with cordless pen or cordless puck)	$995 (with stylus) $1,265 (with 16-button cursor)	$1,315 (with stylus) $1,365 (with 1-button cursor) $1,485 (with 4-button cursor)	$1,495
Overall size of tablet (inches)	8×8	12×13½	16×16	16×15	15¾×15¾	No pad	15×15
Size of workspace (inches)	4½×4½	8½×11	12×12	12×12	11×11	26×20	11×11
Templates available	○	○	○	●	○	○	●
Programmable	○	○	○	●	●	●	●
Pointing devices:							
Pen	○	○	○	●	○	○	●
Stylus	●	○	●	●	●	●	○
Cursor	○	○	●	●	●	●	Optional
Other	●*	Mechanical arm	○	○	○	○	○
Software included	*PC Illustrator*	*VerseWriter Drawing System*	None	IS/Template Software (driver for *Microsoft Windows*), IS/PenSmith (Microsoft Mouse driver)	None	None	Mouse driver and either *Penform, Pencad, Pendraw,* or *Software Toolkit*
Port used for input	Game	Game	Serial	Serial	Serial	Serial	Requires own interface card

Applications Supported

	KoalaPad + Touch Tablet	VerseWriter	SummaSketch 1201	IS/ONE Series Tablet	Digi-Pad Type 5A Model 1111A	GP-7 Grafbar Mark II Sonic Digitizer	Pencept Penpad Model 320
Microsoft Windows	○	○	●	●	●	○	●
AutoCAD	○	○	●	●	●	●	●
VersaCAD	○	○	●	●	●	●	●
PC Paintbrush	○	○	●	●	●	○	●
Freelance Plus	○	○	●	●	●	○	●
Dr. Halo	○	○	●	●	●	○	●
PageMaker	○	○	●	●	●	○	○
Ventura Publisher	○	○	●	●	●	○	○

PC—Indicates Editor's Choice ●—Yes ○—No **PC Illustrator* software has drivers for Microsoft-compatible mice, the Summagraphics Bit Pad One, and light pens.

ting a switch. The remaining half notify you when something serious is wrong. You might find it somewhat difficult to hear the warning tones, though, if your office has a moderate amount of background noise, from, say, cooling fans and idling printers.

USING STYLUS AND CURSOR Both the stylus and the 16-button cursor model of the Digi-Pad worked well when I used them with *AutoCAD*. The only two problems that I found when using the stylus were that the Digi-Pad's "out-of-range" alarm sounded when I laid the stylus on its side on the pad surface, and that the stylus tended to roll off the pad if its cable wasn't looped across the back corner of the pad.

■ The Digi-Pad has an audible alarm system that emits a series of different tones in different patterns to tell you the status of the pad.

The cursor model was much easier to use, since its 16 buttons speed the selection of commands. The "0" button acts as the "pick" button, and the next nine are mapped according to the standard *AutoCAD* menu items (which are listed in the documentation and include handy options such as Cancel and Snap, which toggles on and off).

The GTCO Digi-Pad Type 5A Model 1111A depends heavily on your applications software for driver support. But if your software includes driver support along with the necessary configuration information, you'll have an easy time using the versatile Digi-Pad.—**Alfred Poor**

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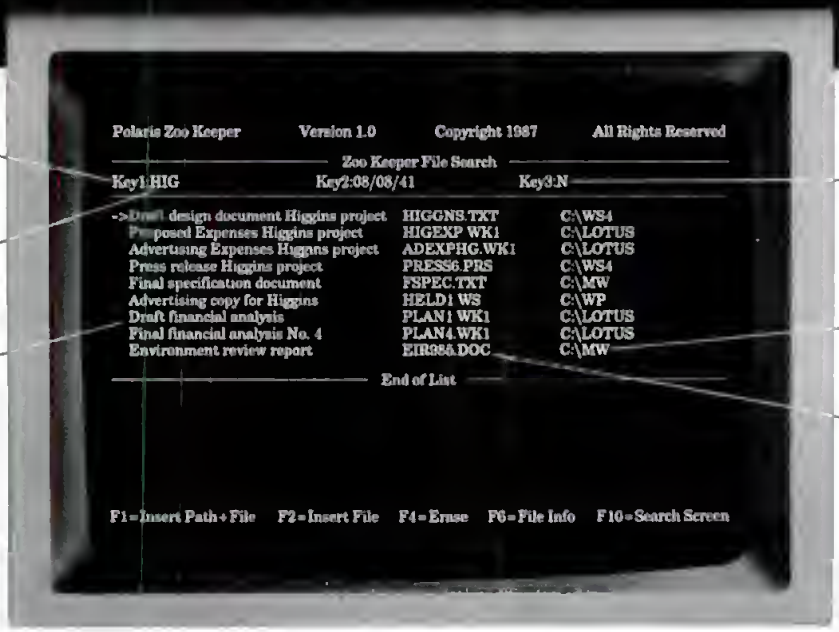

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KOALA TECHNOLOGIES INC.

KoalaPad+ Touch Tablet

At first glance the KoalaPad+ Touch Tablet, sold by Koala Technologies for $163, seems to be the ideal interface between drawing programs and less-than-dexterous hands: it's compact, requires no special interface card, and can accept input from a stylus or a fingertip.

The KoalaPad+ Touch Tablet package includes a pad, a stylus, *PC Illustrator* software, and documentation. Installing the hardware is quite simple. Rather than having to install an interface card, you just plug the pad into the game port.

The 6- by 8-inch pad, which fits nicely in your hand, has a 4½-inch-square drawing area. Its small size, however, does not limit drawing accuracy. Holding the pad in one hand while drawing with your other is quite comfortable. You can use the stylus that comes with the KoalaPad+ or you can use your finger to draw, but almost any pointed object that isn't too sharp (like a ballpoint pen) will do.

The pad has two buttons at the top that are mapped for your application. With some paint programs, these buttons corresponded to mouse buttons, but I was unable to make much use of them. The only time the buttons worked correctly was with the KoalaPad+'s *PC Illustrator* software.

SOFTWARE The KoalaPad+ *PC Illustrator* software combines paint-type graphics, text, and business graphics under a single menu system. You can use either the keyboard or the KoalaPad+ to select menu items, such as graphics primitives (line, circle, arc, rectangle, and so forth), and freehand drawing options, plus a chart program and a slide show. *PC Illustrator* also has a screen capture program that lets you import other screens into the software.

Configured for the KoalaPad+, *PC Illustrator* supports a variety of dot matrix printers and ink jet printers, including several color ink jets, as well as a variety of input devices such as Microsoft-compatible mice, the Summagraphics Bit Pad One, and light pens.

The software supports the standard CGA mode (four colors, 320 by 200 pixels). You can change palettes using a pointer or the function keys, for a total of 12 possible colors. *PC Illustrator* does not support the EGA mode.

The software package, which reminded me of using primitive graphics programs, made me really appreciate modern, easy-to-use graphics packages like *Harvard Presentation Graphics* and *Freelance Plus*. To change from one drawing mode to another, for example, you must switch back and forth between the drawing screen and the menu screen. Although you do get a full screen with which to edit, this interface is cumbersome even when you use the KoalaPad+.

Further, the KoalaPad+ is not well adapted to the drawing screen. To draw a freehand line, for instance, you must hold down a key or a button on the touch tablet. Using a mouse is far easier than using the KoalaPad+.

The package also lacks any facility for importing data; you must enter it by hand. And the software uses a proprietary file structure, which renders the graphics virtually useless with other graphics or desktop publishing applications.

OTHER APPLICATIONS Not only is the KoalaPad+ difficult to use with Koala's own software, but it has no easy interfaces to my favorite paint programs. In theory, any software that can use joystick input should support the KoalaPad+. But, in practice, this was impossible.

For instance, *PC Paintbrush*, which accepts joystick input, was unable to use KoalaPad+ input. When I tried using *PC*

The 6- by 8-inch KoalaPad+ Touch Tablet fits easily in your hand. The pad, which provides a 4½-inch-square drawing area, can accept input from a stylus or your fingertip.

PC MAGAZINE FACT FILE

KoalaPad+ Touch Tablet
Koala Technologies Inc.
269 Mount Hermon Rd.
Scotts Valley, CA 95066-4029
(408) 438-0946
List Price: $163 (including *PC Illustrator*).
Requires: Game port.
In Short: The KoalaPad+ Touch Tablet is a compact digitizer that works well with its own customized software and with almost nothing else.

CIRCLE 625 ON READER SERVICE CARD

Paintbrush with the KoalaPad+, the pointer jumped wildly over the screen, froze, then disappeared altogether. Experimentation and calls to the vendor produced no improvement. And the KoalaPad+ doesn't even come with the Koala Technologies Programmer's Guide to help you write your own drivers.

In addition, the KoalaPad+ documentation is almost nonexistent. To find out how to use the driver software, I had to study the manual for *PC Illustrator*. And while the manual emphasizes how to install a mouse or digitizers for use with *PC Illustrator*, it fails to mention how to use the KoalaPad+ with other paint programs or CAD packages.

With a better interface, clear documentation, and driver support for other, more-sophisticated CAD and graphics packages, using the KoalaPad+ Touch Tablet would be both fun and effective—as well as easy on the budget. It's the ideal size for someone who doesn't really need a full-size digitizer but who wants a small, easy-to-handle pad for sketching and designing. But Koala's poor support, scant documentation, and *PC Illustrator* software make me wonder why they even bother marketing the hardware.—**Tom Stanton**

Kurta's IS/ONE Series Tablet accepts input from a stylus, wireless pen, four-button cursor, or wireless four-button cursor. The tablet's surface is fully programmable. For instance, you can program the ten soft-switches at the top of the tablet for a particular application or use them as the keyboard's ten function keys.

KURTA CORP.

IS/ONE Series Tablet

Early in 1986, Kurta Corp. introduced the IS/PenMouse, a small 6- by 9-inch tablet that uses a wireless stylus. While the IS/PenMouse was itself an outstanding product, the latest IS/ONE Series Tablet from Kurta takes the IS/PenMouse's superior engineering another step further.

At first glance, this product line resembles any standard line of digitizing tablets. But the $895 IS/ONE Series Tablet is far more. It performs more like the control console for your computer application than a point-and-select interface. The tablet provides a 12-inch-square working area and is packaged with the connecting cables, an in-depth manual, driver software (for use with *Microsoft Windows*), and your choice of pointing device.

FOUR POINTING DEVICES The four pointing devices available are a stylus, a wireless pen, a four-button cursor, and even a wireless four-button cursor.

The conventional stylus is wired to the tablet. Although it is basic in appearance, this stylus has a wide range of possibilities. When used in combination with a series of four stylus-select buttons located on the upper surface of the tablet, it gives you a variety of options.

The stylus-select buttons allow you to configure the stylus for optimal operation. For instance, one select button will allow you to use the soft click in the tip of the pen, which you may want if you are going to draw with the pen. Another button allows a full click, perfect for pointing and selecting from a menu area.

The wireless pen uses radio waves to communicate with the tablet. A small battery in the barrel of the pen powers a tiny

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

IS/ONE Series Tablet
Kurta Corp.
4610 South 35th St.
Phoenix, AZ 85040
(602) 276-5533
List Price: $895 (with corded pen or corded puck); $995 (with cordless pen or cordless puck); tS/PenMouse, $295.
Requires: Serial port.
In Short: The most full-featured tablet on the market, it's compatible with most software applications and is fully programmable. Its outstanding feature is the *AutoCAD* and *PageMaker* configuration, complete with templates for the tablet surface.

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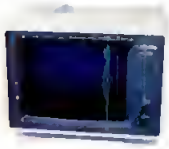

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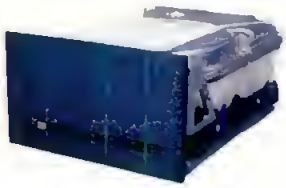

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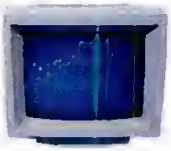

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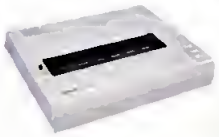

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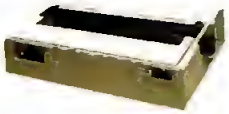

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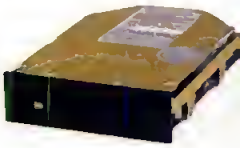

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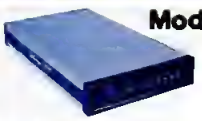

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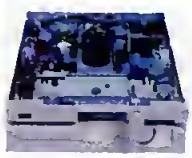

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■ One of the many extraordinary features of the IS/ONE Series Tablet is that you can configure it to operate with up to five different applications programs.

transmitter, and the tablet is its receiver.

The handy wireless pen has switches in three places: one in the barrel and two on the side of the pen. Both of the side-mounted switches have a unique shape to help you distinguish between them. You can operate the switches by themselves or in concert, just as a mouse can be programmed to use its three buttons singly or in any combination.

The latest pointer offered by Kurta is the four-button cursor, available in two versions: wired and wireless. Among the many unique features of the IS/ONE Series Tablet is the way the cursor is powered.

As with the wireless pen, the wireless cursor has a battery on-board. The battery is resident but not on when the cursor is not in use. The power is turned on only when your fingers hold both sides of the cursor. Hence you use the power only when you need it. The principle is simple: your fingers are the final ground needed to complete the electrical circuit that draws on the batteries for power.

PROGRAMMABILITY The tablet and its surface are fully programmable. You may, for instance, define areas of the pad as menu-select areas, just as the manufacturer has done with the *Windows* and *AutoCAD* templates.

The templates are surface menus, basically sheets of plastic with preprinted commands. The commands are grouped and color-coded to simplify their use. When using one of these templates with the appropriate software package, you may select from a menu item on the template and activate that command.

This feature is extremely useful when using software that has many menus. Using the tablet with *Windows*, for instance, you can select an item without going to the pull-down window. The primary functions for *Windows Write*, *Windows Draw*, Executive, and System are all laid out neatly on the surface menu.

SETTING UP FOR WINDOWS To set up the tablet for use with *Windows*, you must follow a short and simple procedure that replaces the mouse drivers in your SETUP file with the Kurta IS/ONE drivers. But I found that having no mouse driver available was a bit disappointing—switching back and forth between a mouse and the tablet would be nice.

Once you're in *Windows*, things could get a bit confusing if you're an infrequent user. The tablet includes a Kurta program that has a *PageMaker* driver. Calling up the program from inside *Windows*, you must set up the K_PMAKER.TOF configuration before using *PageMaker*.

You can save and install this configuration automatically when booting up *Windows*, at which point you can also define and coordinate the position of the command template. Once again, the process is well documented, and the screen display leads you through the process.

You define the work area separately from the command template area. The screen area can be as large as the tablet or as small as you like.

The details of programming the tablet to fit your needs may be a bit time-consuming. But the added flexibility will make it worth your while.

APPLICATIONS SUPPORT One of the many extraordinary features of the tablet is that you can configure it to operate with up to five different applications programs. This proves very useful in a computer application like mine in which *AutoCAD*, *Windows*, *Dr. Halo*, *PageMaker*, and West End Film's *Artwork* are all loaded onto the same computer. Rather than rebooting and reconfiguring the tablet, you need select only one of the five soft-select program switches that run across the top of the tablet. You can preset the switches to fit your application's needs.

Also residing at the top of the tablet is a set of ten function soft-switches. You can custom program them to fit the needs of your application, or they can act as the keyboard's ten function keys.

The Kurta IS/ONE Series Tablet is an extremely powerful tablet that offers so much more than the ability to point and select. If being productive is the issue, the programmable IS/ONE Series Tablet can speed you along. Its $895 price tag may be a bit more than that of some other tablets on the market, but it is still a great value. If you are an *AutoCAD* user, this is one product that will immediately pay for itself in the time you'll save.—**Gerard Kunkel**

PENCEPT INC.

Pencept Penpad Model 320

The Pencept Penpad Model 320 mimics the traditional drawing tools—pencil and paper—in more ways than one. Excellent for drawing, the Penpad can also read hand-written text.

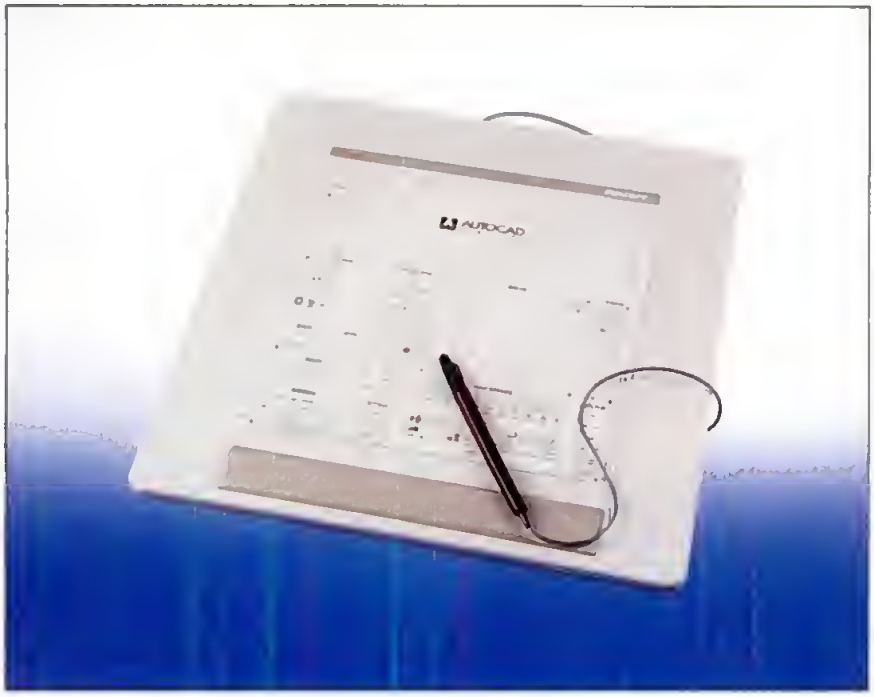
Well designed and built, the $1,495 Penpad system includes an interface card, drawing tablet, and pen (a cursor is optional) and comes with a cornucopia of useful software.

It offers extensive support for CAD applications including software drivers, templates that fit over the tablet and have customized menu commands on them, and a utility that defines macros and maps them

PC MAGAZINE FACT FILE

Pencept Penpad Model 320
Pencept Inc
39 Green St.
Waltham, MA 02154
(617) 893-6390
List Price: $1,495 (including mouse driver and one of the following applications packages: *Penform*, *Pencad*, *Pendraw*, or *Software Toolkit*).
Requires: One full-length slot.
In Short: A versatile input device that can be used with CAD, paint-type graphics, or for text/data entry.

CIRCLE 623 ON READER SERVICE CARD



The Pencept Penpad Model 320 uses a grid of sensors to determine the position of the pen and transmit the corresponding x-y coordinate pairs to the applications software.

to existing commands on a template.

The digitizer comes with two templates for *AutoCAD* and one each for *Cadkey*, *Cadvance*, *Freelance*, and *VersaCAD*. Two additional templates are for use with *Penform*—Pencept's form design and data entry software. In addition, the Penpad includes a memory-resident driver for DOS and a Microsoft Mouse–compatible mouse driver.

COMMAND AND DRAWING AREAS In one sense, the Penpad resembles an optical mouse, which digitizes motion across a special pad. The Penpad tablet contains a grid of sensors that sense the position of the pen and transmit the corresponding *x-y* coordinate pairs to the applications software. Like the left button on a mouse, a button near the tip of the pen acts as the Enter key.

The entire tablet is not reserved for drawing. Pencept divides the pad into command areas and drawing areas, depending on the application. You can attach the included templates to the pad to show the areas designated for commands or for drawing. For example, the IBM PC command template, which takes up a quarter of the tablet, contains all ten function keys; the Shift, Alt, Ctrl, and Esc keys; the arrow keypad; and the Tab, Backspace, PrtSc, and Scroll Lock keys. Pointing to a key on the template with the pen is the same as pressing the key.

INSTALLATION Hardware installation is pretty straightforward. The Penpad tablet includes a ready-to-install full-length interface board configured for interrupt 2. The Model A board allows interrupt changes (2, 3, 4, and 7), but you cannot change the hex address, which is fixed at 36C through 36F. The Model B board allows you to change the interrupt (from 2 to 7) and hex address range (either 36C to 36F or 33C to 33F).

Once you've installed the interface board, you plug the pad into the connector and attach the pen or a cursor.

Software installation was easy once I figured out which disk to use. Pencept includes its own installation .BAT file, which overwrites your existing AUTOEXEC.BAT file (to Pencept's credit, it at least makes a backup of your original AUTOEXEC so that you can recover it later).

The Penpad is quite easy to use. After running the Pencept tutorial, which shows you most of the basics, I was able to print DOS commands and run several programs without touching the keyboard. Handling the pen was much easier than handling a mouse, and I soon found myself using the Penpad even for the simplest cursor commands in my word processor and in paint programs.

The pen is easier to use than a mouse. The templates are particularly helpful. Of the two templates supplied for *AutoCAD*, the simpler one gives an experienced user more flexibility, particularly on larger drawings. The templates are so useful that I'd like to see them used for paint programs as well as CAD and graphics programs, particularly for paint programs that support scanners (like *Halo DPE* and *PC Paintbrush Plus*). A template for *PageMaker* or *Ventura Publisher* would make a valuable added feature.

PENFORM The optional *Penform* software package lets you design a form on paper. You can define fields, field length, data type, and required fields on the form. You then load it into the computer.

You can move the fields on the screen if you are dissatisfied with the design. The forms use landscape orientation (11 inches wide by 8½ inches tall), which imitates the screen area, rather than the usual portrait orientation.

Data files from *Penform* are stored as sequential ASCII data, so you can import the information into database managers or spreadsheets. The forms design process was easy to do and well documented.

The Penpad's ability to recognize handprinted characters is primarily for use with the *Penform* software. The idea is that you can fill in forms by hand, while at the same time entering the data into a database.

However, to use this feature, you must learn to print characters that Pencept recognizes. For example, you must draw the letter "I" as one downstroke, followed by a top and bottom stroke because a single stroke produces the number "1." To write lowercase letters, you must use small uppercase letters—no easy feat if your printing isn't very good to start with, and certainly more bother than typing. A typist

keying at only 20 words per minute can enter data much faster than you can print it. Nor does the *Penform* software offer any additional features that might justify entering your data by pen.

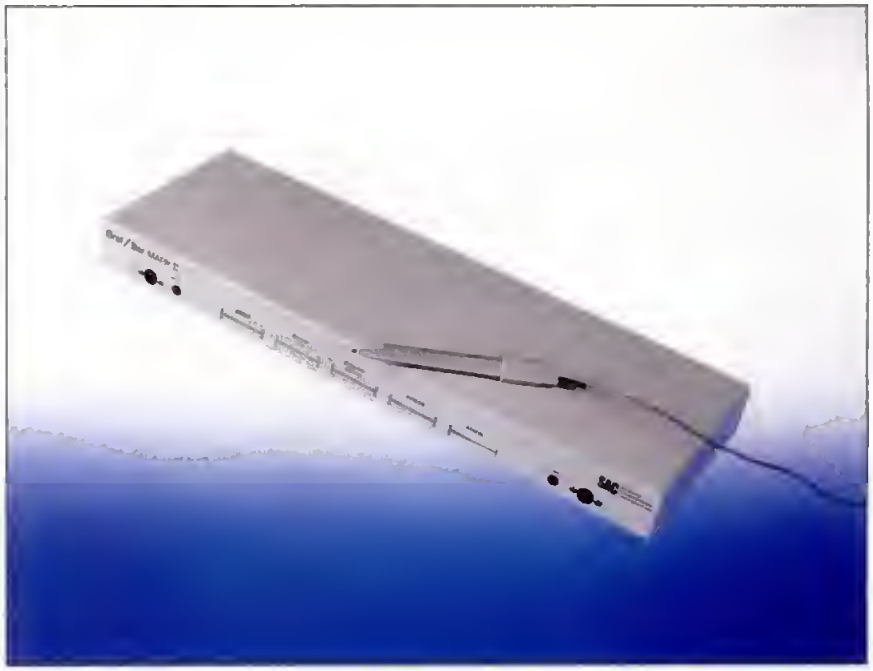
Entering text into the Penpad by hand would be preferable to keying it in only in two situations: designing custom forms that will be used as a printed copy, and as the basis for a database or spreadsheet.

EXCEPTIONAL DRAWING TOOL Overall I found the Penpad to be an exceptional drawing tool. Yet although the Penpad offers the ability to enter text, it is not a true alternative to keyboard text entry. What it primarily has to offer is ease of use, excellent results, and extensive software support. For the artist or designer who is looking for a more natural way to work on a PC, the Penpad is the answer.—**Tom Stanton**

SCIENCE ACCESSORIES CORP.
GP-7 Grafbar Mark II Sonic Digitizer

At $1,315 to $1,485, depending on options, the GP-7 Grafbar Mark II Sonic Digitizer, from Science Accessories Corp., is an unusual digitizer: it has no pad. The GP-7 Grafbar Mark II uses sound to find the pointer position so you can use the digitizer on many kinds of surfaces.

Most digitizing pads are just that: pads. You must do all your work on a large flat panel. If the pad works by responding to pressure, then the thickness of your worksheet may affect the resolution of the input and thus the quality of the data. You'll have additional problems if your original is larger than the pad surface.



An unusual digitizer, the GP-7 Grafbar Mork II Sonic Digitizer has no pad. It uses sound to locote the pointer position, so you con use the digitizer for your work.

In the past, some manufacturers have tried to introduce digitizing devices without a pad, including a unit that had two strings attached to the stylus; by measuring the length of the string from each of the two spools, the unit could determine where the stylus was located. The concept was interesting, but the device was clumsy.

The padless GP-7 Grafbar Mark II uses the two-point concept, minus the strings, for its no-pad digitizing pad (Science Accessories Corp. was actually using this design before the string-based design appeared). The device consists of a 6½- by 19-inch box that is only 2 inches tall and comes with either a cursor or a stylus. Across the back, the digitizer has a power switch, a standard power cord, a connector for the pointing device, and a serial port. You can reach the set of DIP switches inside the box by removing the top.

MICROPHONES The magic of the GP-7 Grafbar Mark II is performed by two black, circular devices mounted on the front panel of the unit. These microphones can register sounds far higher in pitch than human hearing can recognize. The upper limit of most people's hearing is around 20 MHz, and the GP-7 Grafbar Mark II relies on sounds in the 65- to 75-MHz range emitted by the stylus or the cursor.

The digitizer measures the time it takes for the sound to reach the microphones. By performing triangulation based on the data received from the two separate microphones, the unit is able to determine the pointer's position on the table surface in front of it.

As a result, you can use the "pad" on any surface, including a desk, drafting table, or light box. It has a working area of 26 by 20 inches, and if your workspace happens to be smaller than that, you can simply "wave" the pointer in space and then press the trigger (stylus point or cursor button) to register the point with the GP-7 Grafbar Mark II.

I ran the GP-7 Grafbar Mark II with *AutoCAD*, using the Grafbar GP-8 driver according to Science Accessories phone support instructions. It worked extremely well, and I found that I was able to control the cursor and select commands with ease.

PC MAGAZINE FACT FILE

GP-7 Grafbar Mark II Sonic Digitizer
Science Accessories Corp.
970 Kings Highway West
Southport, CT 06490
(203) 255-1526
List Price: $1,315 (including stylus); $1,365 (with one-button cursor); $1,485 (with four-button cursor).
Requires: Serial port.
In Short: An unusual digitizer that has no pad, using sound instead to locate the pointer position so that it can be used on a wide range of work surfaces.

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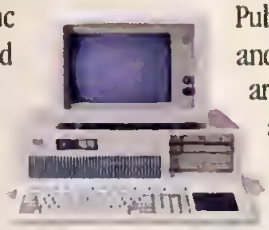

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CIRCLE 244 ON READER SERVICE CARD

The GP-7 Grafbar Mark II has a menu area across its front. If you click the pointer right in front of the labeled areas, you can set the work area origin, toggle between point and line modes, and toggle the stream mode (for constant registration of points).

You use the stream mode with *AutoCAD*. I was pleased to find that the stream mode could still differentiate between a point located by the pointer's position and a point that is selected by clicking. This made it easy to access the *AutoCAD* menus and use the various commands; I almost never had to reach for the keyboard.

MANUAL The manual includes a simple BASIC diagnostic program. Using it, I discovered that the pointer registers positions with an accuracy of up to 1/100 inch. The program displays the ASCII output that the GP-7 Grafbar Mark II generates to describe its position.

The unit comes with no special drivers; hence either your software must support the device or you will have to write your own. If writing custom software drivers is your cup of tea, Software Accessories goes a long way to help you out. The documentation is very technical, detailing all the configuration options and coordinate-data ASCII formats; it even offers schematic diagrams.

Included in the documentation but not readily accessible is some basic information about how to set up and use the GP-7 Grafbar Mark II. I'd like to see additions to the documentation covering such topics as how to set up the GP-7 Grafbar Mark II with *AutoCAD*.

The other drawback of the GP-7 Grafbar Mark II is that the stylus uses a clearly audible click, created by a small spark at its tip, when generating its sonic impulse. The sound is not particulary loud, but when you enter the stream mode, the constant noise quickly becomes annoying. According to Software Accessories, the cursor uses a different technique, involving a piezoelectric ceramic to generate the signal, which cannot be heard. Unless you listen to a Walkman while you work, I recommend the cursor over the stylus.

Flexible, precise, and elegant, the GP-7 Grafbar Mark II uses a clever design to build a digitizing device that frees you from many of the physical constraints imposed by traditional pad-based products.—**Alfred Poor**

SUMMAGRAPHICS CORP.
SummaSketch 1201

Installing and operating a digitizing tablet should be a simple task. You should be able to begin pointing and selecting right away. With the SummaSketch 1201, from Summagraphics Corp., unlike with other tablets on the market, you can.

To install this $599 system, you simply connect the tablet's RS-232 cable to your computer's asynchronous adapter, plug the stylus or cursor into the telephone-type jack on the underside of the tablet, plug in the tablet power supply, configure your applications software, and then begin to point, select, and draw.

Using the SummaSketch tablet can have some drawbacks, though. It does not come with its own software driver. You must use it with an applications program that supports this device, such as *AutoCAD*, *Dr. Halo*, *VersaCAD*, and *PC Paintbrush*.

The SummaSketch does not support Micrografx's *Windows Draw* or Microsoft's *Windows Paint* programs, nor can it currently emulate the Microsoft Mouse.

STYLUS OR CURSOR The SummaSketch 1201 lets you choose between two pointing devices: a stylus and a cursor. The stylus is similar in shape to a fountain pen, but slightly more bulky and has a wire attached to the back end.

The cursor has a four-button control cluster in the center of its top, with the buttons facing north, south, east, and west. When using SummaSketch with *Auto-*

PC MAGAZINE FACT FILE

SummaSketch 1201
Summagraphics Corp.
777 Commerce Dr.
Fairfield, CT 06430
(203) 384-1344
List Price: $599; SummaSketch 961, $449.
Requires: Serial port, any applications software that contains the Summagraphics 1201 device driver.
In Short: A well-made, easy-to-use, simple-to-install, digitizing tablet that will serve all of your point-and-select needs.
CIRCLE 621 ON READER SERVICE CARD

Unlike other tablets on the market, the 16- by 16-inch SummaSketch 1201 is easy to install and operate. It provides a 12-inch-square work area and accepts input from a stylus and a cursor.

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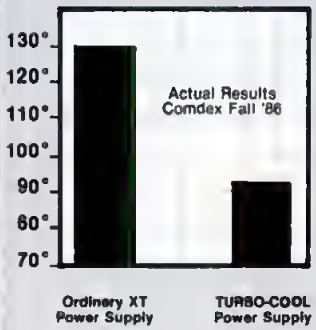
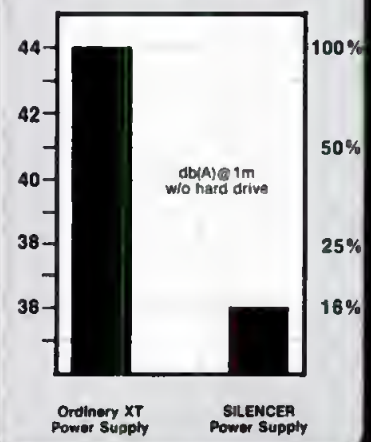


NOISE LEVELS



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CIRCLE 473 ON READER SERVICE CARD

■ Both SummaSketch tablets have excellent accuracy and are very easy to set up and use.

CAD, the north button is your point and select, east and south are definable to meet your CAD needs, and west serves as your Enter key.

The overall dimensions of the tablet are 16 by 16 inches. The work area is a 12- by 12-inch surface. If this is too great a sacrifice of desktop space, try Summagraphics' 6- by 9-inch work area tablet called the SummaSketch Model 961.

While this less expensive model ($449) is functionally the same as the Model 1201, it comes with a stylus only. The cursor is available as an option.

FIRST RATE Both SummaSketch tablets have excellent accuracy: the resolution they each produce is 1,000 points per inch, and both of them are very easy to use as well as to set up.

The construction, documentation, installation, and ease of use of the SummaSketch models are by far first rate. If you use *AutoCAD*, *Dr. Halo*, *VersaCAD*, and *PC Paintbrush*, or any other program that may offer drivers for the devices, you'll find it very easy to begin drawing and designing with them.

While many other tablets offer more features, they also require a great deal more configuration and may cost a great deal more. If you're looking for easy pointing and selecting and your pointing device requirements are simple (equal to, or not much greater than, that offered by a mouse), you'll want to give a SummaSketch tablet a try.—**Gerard Kunkel**

VERSA COMPUTING INC.

VersaWriter

In an age of optical mice, light pens, and touch-screens, the VersaWriter is quaint but useful. Versa Computing's $299 VersaWriter system is unique: it uses a mechanical arm for input as opposed to a stylus, pen, or cursor. The software that comes with the VersaWriter resembles most paint programs and has a number of good features.

The VersaWriter system is not a digitizing tablet in the strictest sense. Unlike most digitizing tablets, which contain sensors, the drawing surface of the VersaWriter is simply an opaque plastic board. A double-jointed arm does the digitizing.

Unlike most drawing tablets, which contain sensors, the drawing surface of the VersaWriter is simply an opaque plastic board. A double-jointed mechanical arm does the digitizing.

PC MAGAZINE FACT FILE

VersaWriter
Versa Computing Inc.
887 Conesloga Circle
Newbury Park, CA 91320
(805) 498-1956
List Price: $299 (including *Versawriter Drawing System*).
Requires: Game port.
In Short: An interesting digitizer that is limited by its proprietary file structure, lack of industry standard drivers, and awkward arm-type pointing device; however it has some nice features in the paint-type software program.

CIRCLE 622 ON READER SERVICE CARD

POTENTIOMETER SYSTEM The arm is mounted in the center of the board and has a cable that connects to the game port. The mounting on the board contains one set of potentiometers; the elbow has another. Together these "pots" supply the *x*-*y* coordinate positions necessary to translate motion into a digital signal.

A lens with cross hairs is the "hand" that acts as the digitizing tool. By moving the lens, you move the position of the two parts of the arm and, consequently, the readings on the two potentiometers.

A joystick works this way, too. But the VersaWriter can sense a range of positions from 0 to 2,048—nearly ten times the range of most joysticks. The VersaWriter has a working resolution of $^{30}/_{1,000}$ inch.

The *Versawriter Drawing System* software is more complete than that of most paint programs; it contains a full range of graphics primitives such as boxes, lines, circles, polygons, and arcs, as well as allowing a freehand mode. It also includes

an airbrush and several palettes and can handle text entry and scaling.

Versawriter picture files are stored in a proprietary format, which makes them incompatible with other applications. The documentation describes how to use BASIC to extract information about these files, but you could also use a paint program like *Dr. Halo II* or *PC Paintbrush* to grab the screen and import portions of the drawing.

INSTALLATION AND USE Hardware installation is simply a matter of plugging the VersaWriter connector into your game port. There is no software installation to speak of, since VersaWriter supports only its own input and the standard CGA, including both a four-color mode (320 by 200) and a two-color mode (640 by 200).

Learning to use the VersaWriter's double-jointed arm requires a lot of practice. While drawing curves with this tool is easy, drawing straight lines is difficult.

In fact, drawing straight lines is impossible unless you use the software's line mode. Since you must focus on the lens and its barely visible cross hairs, I found myself constantly looking back and forth between the screen and the drawing.

I never came to trust the VersaWriter's drawing ability, even after I had traced the map of the United States, which is included as a practice drawing. Freehand drawing was a little easier, but I would prefer using a mouse.

The software is this product's saving grace. Offering more than most standalone paint programs, the *Versawriter Drawing System* uses no menus or icons: instead, it works through a combination of function keys or single-letter commands.

Drawing was fairly easy as long as I stayed with the primitives. The software made boxes, lines, circles, and assorted polygons fairly easy to produce—despite the device's double-jointed arm.

I was impressed with the many features of *Versawriter Drawing System*, particularly the airbrush. You can select different palettes "on the fly" and use color selectively for the graphics primitives and the airbrushed sections.

Printing files is another matter. The documentation dates itself when it describes the "matrix printer equipped with the Graftrax ROM set." It mentions no other matrix printers, quad-density graphics modes, color ink-jet printers, or laser printers.

The VersaWriter system is a law unto itself, with a difficult-to-use input device, proprietary file structures, and dated printer support documentation. Although its software has some valuable painting features, the VersaWriter input device is a poor replacement for a mouse.

—Tom Stanton

■ The software is the VersaWriter's saving grace, offering more than most paint programs.

Gerard Kunkel is technical art director of PC Magazine. *Alfred Poor and Tom Stanton are frequent contributors to* PC Magazine.

EDITOR'S CHOICE

• IS/ONE Series Tablet

Kurta Corp.'s IS/ONE Series Tablet is the hands-down winner in terms of functionality, quality of construction, and price. With its various forms of programmability, it is by far the most adaptable tablet on the market. Kurta's longevity in the personal computer arena has given it a broad range of software support. And, with four options for the type of pointing device (both stylus and cursor available wired or wireless), you can have it just the way you want it. At $895 it is certainly not the cheapest way to input data, but the added features make this a very productive and cost-effective tool.

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CIRCLE 167 ON READER SERVICE CARD

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CIRCLE 343 ON READER SERVICE CARD

TOUCH-SCREENS FOR INTUITIVE INPUT

The touch-screen is brilliant in its simplicity. Like most supplements to the keyboard, it functions primarily as a pointing device. But unlike the mouse, touch-pad, or other input alternative, it lets you use the most direct, natural, and intuitive pointing device of all—your finger.

While you can use your finger as a pointer for all touch-screens, currently available screens use two technologies for interpreting its position: either your finger breaks infrared light beams, or it closes a circuit on the screen's electrically conductive surface. Both types of touch-screens then convert that position into *x-y* coordinates and make the numbers available to software.

The software converts the numbers into marching orders—to move the cursor, give a command, or otherwise act. Consequently, touching the screen has the same effect as hitting a function key, choosing a menu option, or moving and clicking a mouse.

Unfortunately, the simplicity of the concept masks a number of problems. First, the touch-screen is ergonomically flawed. Most people set up their computers so that the top of the screen is roughly at eye level when they're seated. But when you give commands to your computer by pointing at the screen, your arm quickly tires. Even if you exercise regularly with Jane Fonda and "go for the burn," you'd probably rather skip that pleasure while working on a spreadsheet. For extended use, you'll need to place touch-screens well below shoulder level to eliminate fatigue. Alternatively, you'll have to confine their use to short sessions.

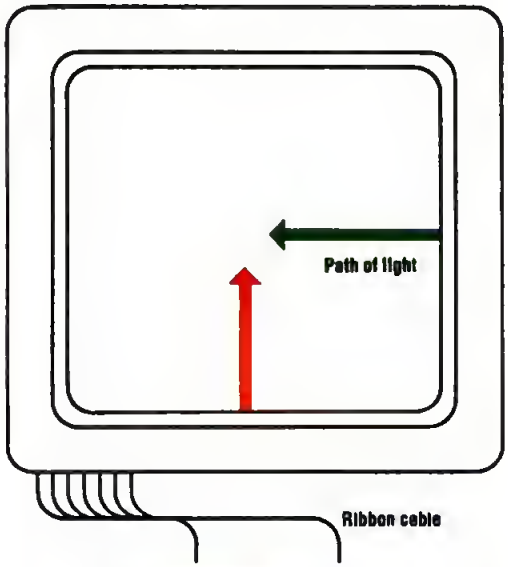
Other relatively minor problems include fingerprints, glare, and parallax. Obviously, when you touch your screen you

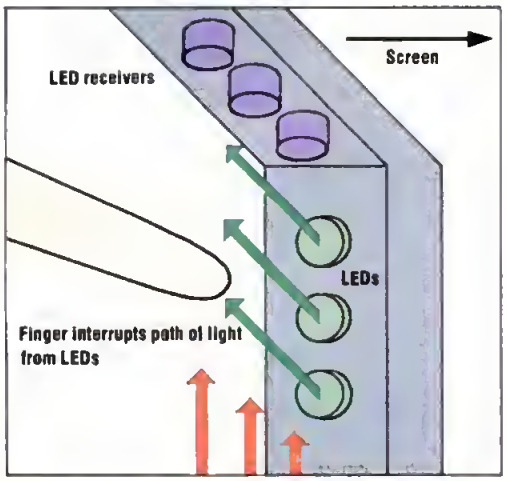
What could be a more natural way to communicate with your PC than by pointing at its screen with your finger? Yet this method has its limitations.

How a Touch-screen Works

LED TECHNOLOGY

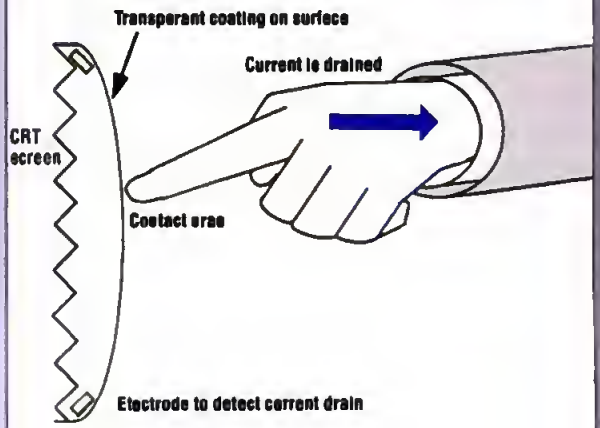
A touch-screen that uses LED technology consists of a bezel fitted with two rows of LEDs—one along the left side and one along the top—placed over the face of the CRT. Opposite each row of LEDs are LED receivers. These LEDs create a matrix of infrared light beams. When your finger points at the screen, it breaks this matrix. The touch-screen electronics send the co-ordinates of the broken beams to the computer, which then calculates the position of the finger on the screen.

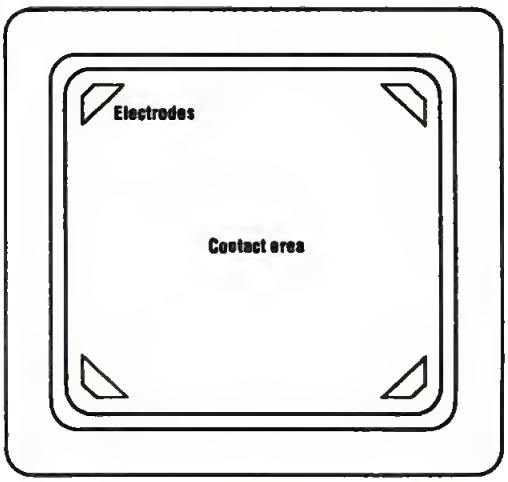




CAPACITIVE TECHNOLOGY

Touch-screens that make use of capacitive technology have a transparent coating fused to the CRT screen that acts as one plate of a capacitor. When a finger touches the coating, it causes a current drain at the contact spot. Electrodes placed at the four corners of the screen detect changes in the current caused by the touch and determine the position of the finger on the screen.





leave fingerprints that increase glare and decrease screen readability, especially on monitors without nonglare surfaces. In working with the touch-screens for this review, I had to wipe the screen several times a day, instead of my usual once every few weeks.

Also, beware of using touch-screens without glare-resistant monitors. If neither your touch-screen nor your monitor are coated to eliminate glare, you'll wind up with reflections from both.

Parallax is caused when the touch-screen is mounted at the outer rim of the display. On some systems this causes a gap as much as an inch wide between the monitor and the screen. If you approach the screen at an angle, you'll overshoot the target coordinates. Some monitors get around this by mounting the touch-screen directly on the monitor screen.

Not surprisingly, the most common touch-screen applications are those that are least affected by the screen's inherent limitations. According to the manufacturers of the three products reviewed here, touch-screens appear most often in shopping center kiosks or similar information displays, where they are used for short periods of time. Other uses include automatic teller machines, control devices on a factory floor, and training systems for flight simulation.

All three manufacturers of products reviewed here consider their market to be original equipment manufacturers (OEMs), value-added resellers (VARs), and system developers. As a result, not one of these packages includes any drivers to emulate a mouse or other device already supported by off-the-shelf programs. And although Personal Touch Corp. and MicroTouch Systems are both looking at ways to use touch-screens without programming, the assumption for now is that developers will write their own software. If that approach doesn't interest you, then you don't want a touch-screen. At least, not yet.

Given these limitations, the following reviews explore the capabilities of the Soft-Touch Touch-Sensitive Screen from Aquila Technologies Group, the MicroTouchScreen from MicroTouch Systems, and the TouchWindow from Personal Touch Corp.

AQUILA TECHNOLOGIES GROUP INC.

Soft-Touch Touch-Sensitive Screen

The $695 Soft-Touch Touch-Sensitive Screen, from Aquila Technologies Group, is actually a frame rather than a screen. The frame sits in front of the monitor screen and projects a grid of infrared beams: 32 vertical and 24 horizontal. Touch your computer screen, and you will break a beam. The Soft-Touch electronics detect and convert such breaks into *x-y* coordinates.

Of the touch-screens reviewed here, the Soft-Touch Screen is unquestionably the most techie-looking. The version for the IBM monitors is a smoky transparent plastic frame. This fits inside the first recessed notch in the monitor's front molding, but not in the deeper recess that would bring it flush to the screen. Clearly visible through the front of the frame are green PC boards, computer chips, resistors, and the infrared sources and detectors.

The Soft-Touch Touch-Sensitive Screen is placed directly over the monitor screen. It uses an LED matrix to determine the position of your finger on the screen.

PC MAGAZINE FACT FILE

Soft-Touch Touch-Sensitive Screen
Aquila Technologies Group Inc
1704 Moon NE
Albuquerque, NM 87112
(505) 292-1212
List Price: With software, controller card, cabling, $695.
Requires: IBM color monitor
In Short: Although you can write programs to run this screen in any language, you must write them all from scratch

CIRCLE 655 ON READER SERVICE CARD

Unlike the other touch-screens reviewed here, the Soft-Touch communicates with the PC through an interface card. Even so, installing the Soft-Touch is easy. The card has no jumpers or DIP switches; instead you just plug it in. With the card installed, all that remains is to peel the protective paper off the self-stick surfaces on the back of the Soft-Touch frame, mount the frame on your monitor, and plug the cable from the frame into the connector on the back of the interface card.

Because the Soft-Touch frame is not flush with the monitor screen, there is a ½- to 1-inch distance between the screen and the infrared light beams. This leads to a slight parallax problem: you can touch one point on the screen while breaking the beams over another. But in practice, this isn't too bothersome.

The screen is not a source of glare (since it doesn't cover the display), but the shiny plastic frame is. While it wasn't distracting when I tested the touch-screen, it was when I wrote this review.

Unlike the other products reviewed here, the Soft-Touch Screen comes with no software at all—not even demonstration software or an optional programmer's toolkit. The interface electronics automatically store the *x-y* coordinates in a specific memory space. Aquila Technologies leaves it to you to write a program to read the memory locations and do something with the data. The only help Aquila offers is a five-line BASIC subroutine showing you how to read and incorporate the data into your own program.

For my tests I wrote a short program to read the coordinates, print the values to the screen, then move the cursor to my finger. Unfortunately, only by trial and error could I discover how to correct my program to make the screen work. For example, I had to discover for myself that BASIC will object to *x-y* coordinates being 0 (they must be at least 1). This was easy enough to fix, but the information should have been included in the documentation.

On the plus side, you can write programs for the Soft-Touch Screen in any language that can read the appropriate memory addresses or can call up an assem-

Photographs: Roberto Braun

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Touch-Screens: Summary of Features

(Products listed in ascending price order)

	TouchWindow	Soft-Touch Touch-Sensitive Screen	MicroTouch Screen
List price	$229 95 (game port version) $289 95 (serial version)	$695 00	$995 00
Number of touch points	256 × 256	25 × 32	1,024 × 1,024
Distsnce of sensors from screen (inches)	0.5 to 1	0.5 to 1	0
Position delection method	Pressure-sensitive membrane switches	Breaking of infrared beams	Capacitive coupling to finger or other conducting object
Programmer's kit available	●	○	●

●—Yes ○—No

bly language subroutine to read those addresses. On the minus side, you must write the entire program from scratch, including the necessary assembly language routines. Missing from this package are any programming tools to make life easier for system developers. But if that doesn't scare you away, the Soft-Touch Screen is certainly in the running.

MICROTOUCH SYSTEMS INC.

MicroTouch Screen

The $995 MicroTouch Screen is available either in kit form or already installed on your choice of about 20 monitors, including the Sony 1271Q, the 19-inch Intecolor EGA monitor, all AYDIN monitors, and the NEC MultiSync.

The kit version includes a touch-screen in the appropriate shape and size for your monitor and the controller electronics for the screen. The screen itself consists of a piece of glass shaped to fit over the monitor screen, inside the monitor case. A transparent, thin-film resistive coating is fused to the outside surface of the glass, with an electrode pattern around its edge. When mounted in the monitor, the electrode pattern is hidden from view.

In the screen we reviewed, the controller electronics were mounted inside the monitor, though they are also available in an external box. In either configuration, the controller applies a voltage to the four corners of the screen. When you touch the screen, a change occurs in the current flowing through it. The controller measures this change. This effect, often used with elevator buttons, is called capacitive coupling. The controller interprets the changes in current flow as *x-y* coordinates and sends the coordinates to the computer's serial port.

MicroTouch Systems insisted on sending us the installed version of its touch-screen. Thus we were unable to judge the ease or difficulty of installing the MicroTouch kit on the monitor. But the monitor itself was easy enough to install. Simply connect the monitor cable to the adapter card and the serial cable to the serial port, plug in the monitor, and turn it on.

One of the unarguable advantages of the MicroTouch Screen is its lack of parallax. Because the screen is mounted directly on the monitor screen, there is no danger of touching a different spot than you mean to. Another plus is the nonglare surface, with three levels of antiglare etch available.

One possible drawback of the capacitive coupling screen is that it will respond only to objects that are electrically conductive. Besides a human finger, this includes a metal pen or a conductive rubber stylus. It does not include a pencil, a plastic pen, or a human fingernail. This last limitation can be a bother if your fingernails are long or if you point with even a slightly bent finger. Also note that although the MicroTouch Screen will respond to a hand wearing thin surgical gloves, it will not respond to a thickly gloved hand.

The demonstration programs that come with the MicroTouch Screen include a four-function calculator, a word processor, and an appointment calendar. This seems a strange choice for a device that won't work with any off-the-shelf software, but they demonstrate what the MicroTouch Screen can do.

The word processor lets you delete text by pointing to a garbage can or move the cursor by pointing. Similarly, the appointment calendar lets you move appointments by pointing. It doesn't take much practice before you can point to individual letters on-screen, and the level of precision is impressive.

Driver software for the MicroTouch Screen is an option. The company offers several programming tool kits. *DrivePoint*, at $125, is a simple device driver that can send raw touch points to an application. *CommandPoint*, a $155 package that requires *DrivePoint* to work, can identify, define, and manage touch zones on-screen. It will also send touch zone numbers to applications.

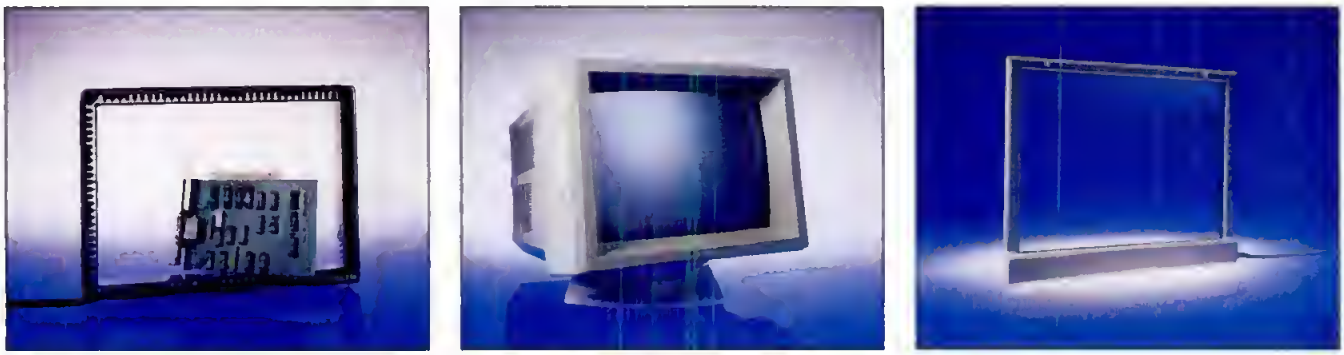
HighPoint, an $875 package that works along with *CommandPoint* and *DrivePoint*, adds the ability to develop screen graphics and build touch zones. *HighPoint*

FACT FILE

MicroTouch Screen
MicroTouch Systems Inc
Ten State St.
Woburn, MA 01801
(617) 935-0080
List Price: With controller card and cabling, $995; DrivePoint Tools, $125; CommandPoint Tools, $155; HighPoint Tools, $875.
Requires: 9- 12- or 13-inch monitor.
In Short: This touch-screen fits directly over the glass portion of your monitor, eliminating parallax and excess glare. MicroTouch systems offers optional driver software in the form of various programming tool kits.

CIRCLE 654 ON READER SERVICE CARD

■ TOUCH-SCREENS



Aquila Technologies Group's Soft-Touch Touch-Sensitive Screen (left), MicroTouch Systems' MicroTouch Screen (center), and Personal Touch's TouchWindow (right) all let you use the most direct pointing device of all—your finger.

comes in different versions for CGA or EGA graphics. A noteworthy feature is that it can use screens created in *Dr. Halo*.

Another optional tool is *KeyPoint*, a $125 RAM-resident program that you can use in conjunction with *HighPoint* to provide a touch-sensitive typewriter-style keyboard, a calculator, two sets of scientific keys, and the entire graphics character set on-screen. Another tool, not yet available at this writing, is a package that will let you enter freehand text on-screen and convert it to ASCII characters.

All the software for the MicroTouch Screen is also available from Skylight Software in a form that will support mice, tablets, light pens, and trackballs, as well as the MicroTouch Screen.

Finally, MicroTouch Systems, like Personal Touch Corp., is aware that their market is more limited than it might be.

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According to a MicroTouch spokesman, the company is currently working on drivers that will emulate popular mice so that you can use the MicroTouch Screen with mouse-driven programs. That's worth keeping in mind if you like the idea of using a touch-screen with a program such as *Windows* or *Microsoft Word*.

PERSONAL TOUCH CORP.

TouchWindow

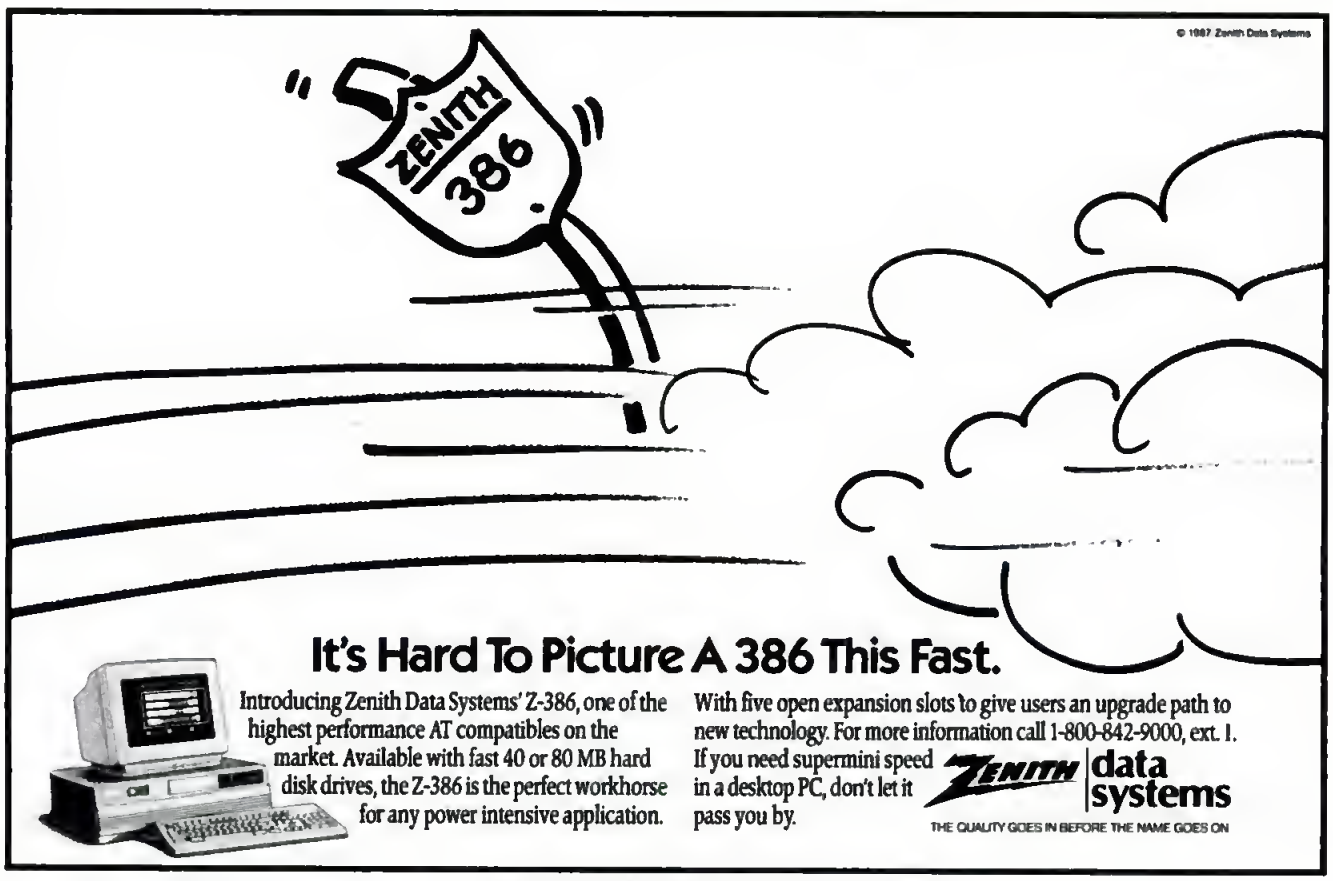
The $229.95 TouchWindow, from Personal Touch Corp., is made from panels of transparent resistive-membrane switches. The switches consist of two thin, flexible sheets of plastic held apart by transparent spacer dots. When you apply mechanical pressure to the panel with a finger or another pointer, the electrically conductive surfaces of the plastic sheets touch each other and close the circuit. One sheet determines the position for the *x*-axis, while the other determines the position for the *y*-axis.

To give the flexible plastic sheets a firm backing, the TouchWindow includes a flat piece of acrylic plastic behind the touch panel. Both touch panel and backing are mounted in a 12-inch-wide by 10-inch-high off-white plastic frame. The result is a window that you can mount on virtually any monitor with a diagonal measurement of 9 to 15 inches.

The TouchWindow comes in two versions for the PC: one connects through the PC's serial port, the other through the game port. Both versions sample the screen dozens of times per second for *x* and *y* contact values. The electronics located in the TouchWindow's frame average the readings and come up with coordinates for the center of the contact area. The *x*-*y* coordinates are sent out through the TouchWindow cable, which connects to your computer's serial port or game port. The game port version has two buttons located on the bottom of the screen's frame that simulate mouse buttons or stylus movement signals in graphics applications.

The Personal Touch TouchWindow is made from panels of resistive-membrane switches. The resulting resistive touch method is similar to that used in touch-pads.

The package includes the TouchWindow, four Velcro strips, a disk, and, for the serial port version supplied for this re-



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view, an external power supply. Installation is simple. You stick the glue-backed Velcro strips on your monitor and on the TouchWindow, mount the TouchWindow on your monitor, plug the TouchWindow cable into the serial port, connect the external power supply to the cable, and plug the power supply into an electrical outlet.

The disk includes the TouchWindow driver and sample programs. Among the samples are a four-function calculator and a world map that calculates the distance between any two points that you touch.

Two possible problems with using the TouchWindow are parallax and glare. Because the TouchWindow is mounted on the front of the monitor, it can be anywhere from ½-inch to a full inch from the monitor screen. Depending on your angle to the screen, you may touch a point different from what you intend. One way to avoid this problem is to buy one of Personal Touch Corp.'s TurboTouch monitors, in which the touch panel is mounted directly on the monitor screen. Screen glare is potentially more troublesome. The touch panel plastic is shiny. I tried it in several lighting situations and invariably saw myself on the TouchWindow. This is bad enough on a nonreflective monitor, but if your monitor already has a reflective screen, you wind up with two sets of reflections, one over the other. Here again, the problem would be minimized with a TurboTouch monitor.

On the plus side, the membrane switch technology means you can touch the panel with anything at all. Moreover, the TouchWindow requires minimal pressure.

The TouchWindow software driver is best described as minimal. Written in assembly language, it filters and smooths the raw data from the TouchWindow and makes the result available to a user-defined interface table. As written, the driver is most easily linked to C programs using either the Lattice C compiler or Microsoft C compiler. A Turbo Pascal version of the driver is also available.

For those who would like help in creating applications, Personal Touch Corp. sells the *TurboTouch Programmer's Toolkit*. This includes the SAYWHAT screen generator program and Personal Touch's own EzTOUCH, a RAM-resident utility and device driver.

PC MAGAZINE FACT FILE

TouchWindow
Personal Touch Corp.
4320 Stevens Creek Blvd., #290
San Jose, CA 95129
(408) 246-8822
List Prices: Game port version, including software, $229.95; serial version, including software, $289.95 *TurboTouch Programmer's Toolkit*, $200.
Requires: Analog game port for game port version; serial port for serial version, 10- to 15-inch monitor.
In Short: A touch-screen that you can touch with anything, not just a finger, the TouchWindow comes with a programmer's tool kit that helps you create applications. Although the screen has a problem with parallax and glare, Personal Touch Corp.'s TurboTouch monitors, in which the touch panel is mounted directly on the monitor's screen, eliminate these problems.

CIRCLE 653 ON READER SERVICE CARD

SAYWHAT lets you create screens that you can call on from within *dBASE*, BASIC, Turbo Pascal, or a number of other programs. EzTOUCH enables you to define touch-active targets within the SAYWHAT screens: it then sends strings of text to your program as if you had typed them at the keyboard.

Personal Touch Corp. is now "looking at" approaches that let buyers use touch-screens without programming. For now, the company isn't willing to be more specific than that, but it may be worth waiting for future developments.

NO EDITOR'S CHOICE We were unable to recommend an editor's choice in this category because all the touch-screens reviewed require far more programming than they reasonably ought to. However, if you are interested in programming your application, the TouchWindow's *TurboTouch Programmer's Toolkit* affords the easiest, least-expensive route for most applications. Where price is not a matter of concern, the MicroTouch Screen may be preferred because of its fine control and lack of parallax. PC

M. David Stone is a contributing editor of PC Magazine.

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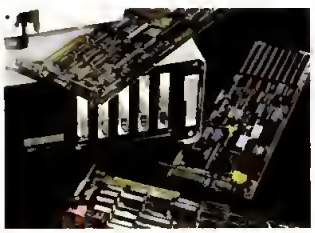

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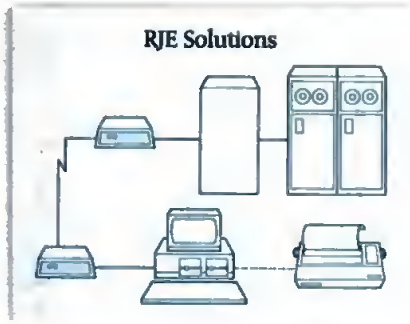

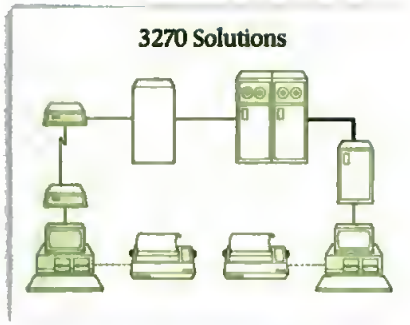

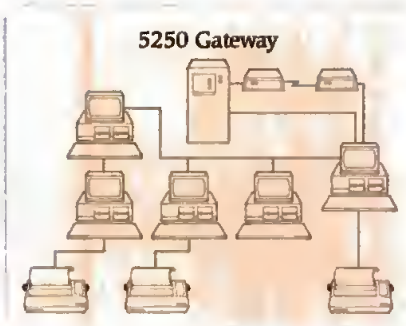

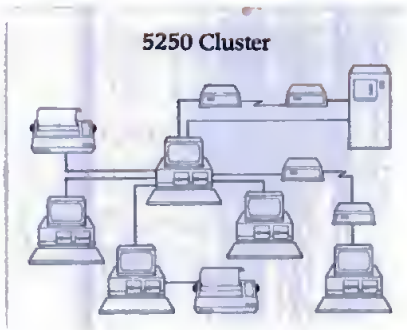

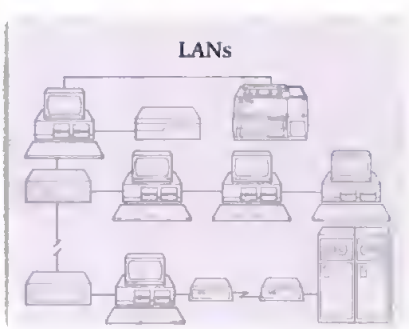

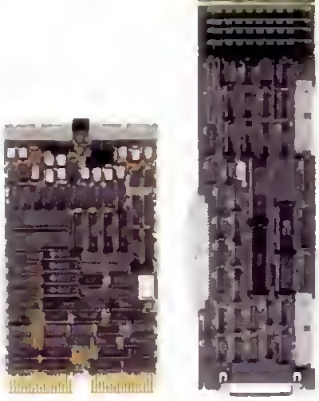

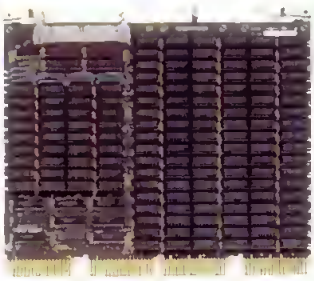

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TRACKBALLS: STATIONARY MICE

Turn a mouse on its back, rub its tummy, and it won't run around. That's the principle behind trackballs.

Essentially mice that do not require desk space to move around on, trackballs still offer the mouse's cursor control and precise movement for menu selection, drawing, and even character input via macros. Instead of moving the mouse around on your desktop, you move the trackball around in its stationary housing. This article looks at three of these alternate input devices: Fulcrum's Trackball Plus and Honeywell's comLYNX and microLYNX trackballs.

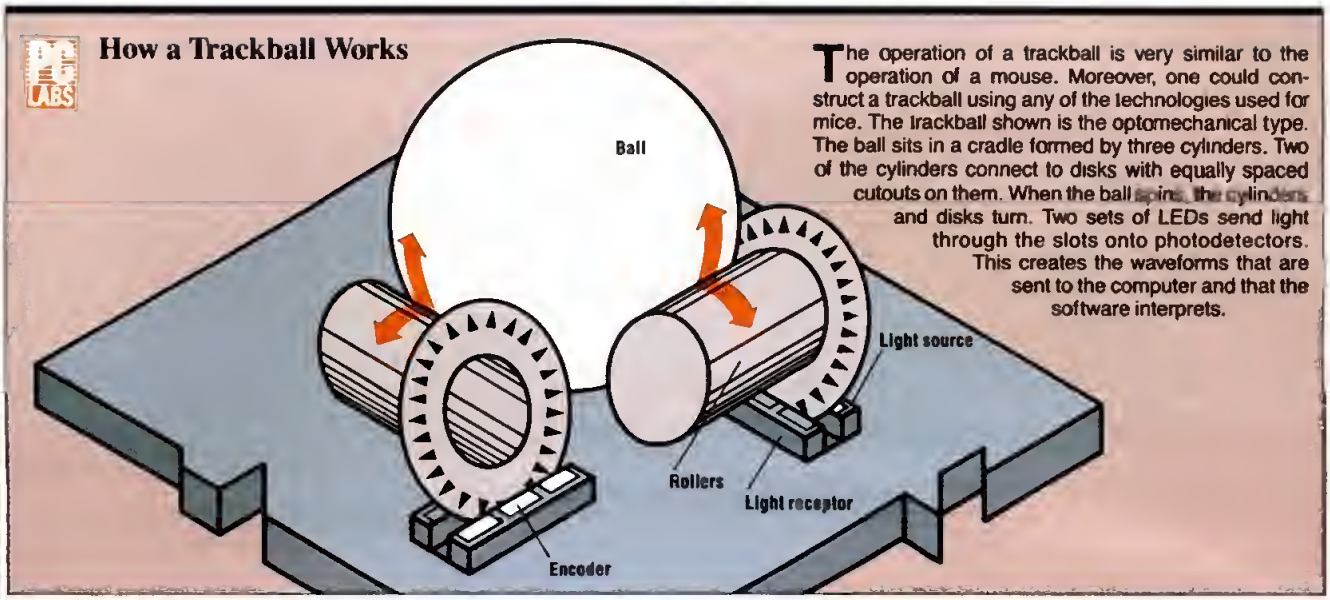
As with their more mobile cousins, the electronic rodents, trackballs can be attached to your PC a number of ways. The Trackball Plus and the comLYNX attach to a PC serial port, while the microLYNX, with the keyboard plugged into its cable, attaches to the PC's keyboard port. The trackballs' inner workings, like those of the mice, are also varied: the two Honeywell trackballs have mechanical position sensors, and the Fulcrum device uses an optical mechanism.

As with other cursor control devices, all trackballs do not yet work with *Windows*, even if they can emulate a Microsoft Mouse. If you're working with *Windows* applications, make sure the device you're interested in will work with them before making your purchase decision.

The only other drawback is that holding down a button and moving the trackball at the same time can be awkward (a problem that Honeywell's comLYNX solves by adding an extra "toggle" button). Otherwise, trackballs have the same advantages as mice.

Trackballs are priced equivalently to mice and do the same job. Whether you choose to use an immobile mouse or a hy-

If you're hooked on mice but not tidy enough or blessed with enough desk space to use one, try a trackball. It's a mouse that can't scurry around.



perkinetic one may be a matter of personal style. If you don't want a mouse scurrying across your desk, you may find that a trackball fits your alternate input needs.

FULCRUM COMPUTER PRODUCTS

Fulcrum Trackball Plus

Fulcrum Computer Products' Fulcrum Trackball Plus is a cursor-control device with a multiple personality. Though it works like a Microsoft Mouse that stays in one place, the $95 Trackball Plus can also emulate other devices.

The Trackball Plus is built with an optical positioning mechanism, so there are few parts to wear out. It has six buttons, all on top of the unit. The buttons are labeled 1, 2, 3, 4, A, and 5. The A button is designed to work as an alternate cursor key for work in such CAD programs as *AutoCAD*).

STARTUP The trackball is a cinch to install. With the computer turned off, you plug the product's serial connector into an available COM port and plug its separate DC power supply into a regular power socket. Boot up, and you're ready to go.

Your first attempt to make practical use of the unit might be frustrating, however, especially if you rely on the manual for guidance. The highly technical documentation is not clearly organized and lacks clear, step-by-step startup instructions.

Press buttons 1, 2, 3, and 5 all at the same time, and you enter a mode selection phase. You then press one or more buttons to select the emulation you want; for instance, you press button number 3 to get the Microsoft Mouse mode. Four of the buttons are extra baggage in the Microsoft Mouse mode, but they come into play with other emulations.

MODES AND DRIVERS The Trackball Plus starts out in the mode that emulates the Summagraphics tablet. To change to another emulation mode, you simply send the unit a software-initiated command.

The Trackball Plus comes with driver options: for Microsoft Mouse emulation and for Mouse Systems mouse emulation. With the Microsoft Mouse mode selected, you must load the Mouse driver. After that you will be able to use the trackball as a mouse. The Trackball Plus emulation driver was one of the few that I tested that functioned with *Windows*.

You must hold down a button to mark text or move a graphic item ("dragging" the cursor) as you do with a mouse. But it's somewhat difficult to hold down the button as you use the trackball to drag, an operation that's easier with a mouse. Honeywell's comLYNX solves this problem with a middle push button that toggles on so you don't have to hold one of the other buttons down continuously. According to a Fulcrum representative, the company plans to implement such a "toggle button" through the driver in a future upgrade.

Aside from this drawback, the Trackball Plus works well, with precise cursor control fairly easy to achieve. CAD users who want the option of emulating a variety of mouse and digitizing pad products will find that the compact, low-priced Trackball Plus can help them get the widest flexibility out of their system without taking up much desk space or requiring much of an investment.

EDITOR'S CHOICE

FACT FILE

Fulcrum Trackball Plus
Fulcrum Computer Products
459 Allan Ct.
Healdsburg, CA 95448
(707) 433-0202
List Price: $95
Requires: DOS 2.0 or later, RS-232 serial port.
In Short: A compact, low-priced trackball that can emulate a Microsoft Mouse, a Mouse Systems mouse, or a USI OptoMouse, as well as the Summagraphics Bit Pad, the Houston Instrument Hipad, and the Tektronics Plot 10.

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HONEYWELL INFORMATION SYSTEMS INC.

comLYNX
microLYNX

The microLYNX and the comLYNX trackballs, from Honeywell Information Systems, are as identical as twins with this single exception: they hook up to different parts of your PC. The microLYNX connects to the PC's keyboard port along with your keyboard, whereas the comLYNX attaches to a serial port. Both these products sell for $169.

Each of the units has a large, black trackball mounted in an 8½- by 3-inch beige housing. Below the trackball, three push buttons serve various functions depending on how the unit is configured.

When you first power up, the unit's default is set in text mode. Turning the trackball produces the same effect as pressing the cursor keys. The three push buttons are fully programmable, and you can set them to produce up to 30 characters each as macros. You can also choose to adjust the cursor movement speed when in the text mode.

THE "DRAGGING DILEMMA" For graphics programs, both the microLYNX and comLYNX units emulate a Microsoft Mouse. You use them to move the cursor and perform a "dragging" movement to mark text or to move a graphic item. The two outer push buttons located below the ball operate like the mouse's buttons, which you hold down in order to perform a "drag."

But trying to hold a button down while moving around the trackball is at best a difficult maneuver. Honeywell has solved this problem on the comLYNX by using a third push button between the two outer ones. You press the middle button first, then one of the outside buttons, and that generates the same effect as if you held down the outside button continuously. Pressing any of the three push buttons releases the dragging effect. This feature is

Trackballs: Summary of Features

(Products listed in ascending price order)

	Fulcrum Trackball Plus	comLYNX	microLYNX
List price	$95	$169	$169
Size of housing (inches)	4½ × 5	8½ × 3	8½ × 3
Position sensors	Optical	Mechanical	Mechanical
Interface	Serial	Serial	Keyboard
Number of buttons	6	3	3
Power supply	External	External	None*
Menu generator	None	None	None
Software included	None	Pop-Up Menu†	Pop-Up Menu†
Mouse emulation	Microsoft, Mouse Systems	Microsoft	Microsoft

Applications Supported

	Fulcrum Trackball Plus	comLYNX	microLYNX
Microsoft Windows	●	○	○
1-2-3	●	●	●
Microsoft Word	●	○	○
WordStar	○	●	●
WordPerfect	○	●	●
AutoCAD	●	●	●
VersaCAD	●	●	●
PC Paintbrush	●	○	●
Freelance Plus	●	○	○
Dr. Halo	●	●	○
PageMaker	●	○	○
Ventura Publisher	●	○	○

— Indicates Editor's Choice ●—Yes ○—No *Uses PC's power supply †The Pop-Up Menu is a separate memory routine that produces a pop-up window in which you can program the trackball button macros and adjust cursor speed

FACT FILE

comLYNX
Honeywell Information Systems Inc.
Operator Interface Group
102 E. Baker St.
Costa Mesa, CA 92626
(800) 824-3522
(714) 979-5300
List Price: $169
Requires: DOS 2.0 or later, serial port configured as COM1 or COM2.
In Short: A solidly built serial port trackball that needs less space than a mouse. Its innovative third button adequately solves the problem of "dragging" by toggling the other two buttons on and off, thereby eliminating the need to hold one down while you're moving the trackball.

CIRCLE **650** ON READER SERVICE CARD

microLYNX
Honeywell Information Systems Inc.
Operator Interface Group
102 E. Baker St.
Costa Mesa, CA 92626
(800) 824-3522
(714) 979-5300
List Price: $169
Requires: DOS 2.0 or later.
In Short: A solidly built trackball that connects to the keyboard port and takes up less space than a mouse. Unlike the comLYNX, the microLYNX suffers slightly from the awkwardness of having to hold down one of the buttons to "drag" the cursor while you're moving the trackball to indicate the direction and extent of drag.

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■ TRACKBALLS

The Fulcrum Trackball Plus (left), from Fulcrum Computer Products, offers precise cursor control and the ability to emulate a wide variety of mice and digitizing pads. The comLYNX (center) and microLYNX (right), from Honeywell Information Systems, emulate the Microsoft Mouse but do not work with Windows.

PC MAGAZINE EDITOR'S CHOICE

- **Fulcrum Trackball Plus**

Trackballs still have a way to go, but of the three reviewed here the nod goes to the Fulcrum Trackball Plus. While its $95 price is as low as the least-expensive mouse, it also emulates a wide range of other input devices, such as the Microsoft Mouse, the IMSI OptiMouse, and numerous digitizing tablets, such as the Summagraphics Bit Pad, the Houston Instrument Hipad, and the Tektronics Plot 10. Flexibility and value give it the edge over the competition.

not included on the microLYNX.

Both trackballs come with two sets of programs. The first is a driver that enables the trackballs to emulate the Microsoft Mouse. (They do not, however, work with *Windows*.) The second program is a separate memory routine that produces a pop-up window in which you can program the trackball button macros and adjust cursor speed.

The comLYNX came through with an unreadable disk, which was replaced by the vendor too late for us to review for this issue. However, I was able to work with the microLYNX. The software works just fine, and the text mode set-up program is both easy and intuitive. The clearly written manuals describe adequately how to operate the units.

Overall, these trackballs are viable alternatives to standard mice. While they are larger than mice, their stationary habits should make them easier to live with. Until the microLYNX finds a better way to drag, such as using a third button, my nod goes to the comLYNX. PC

Alfred Poor is a frequent contributor to PC Magazine.

Photograph: Roberto Brosan

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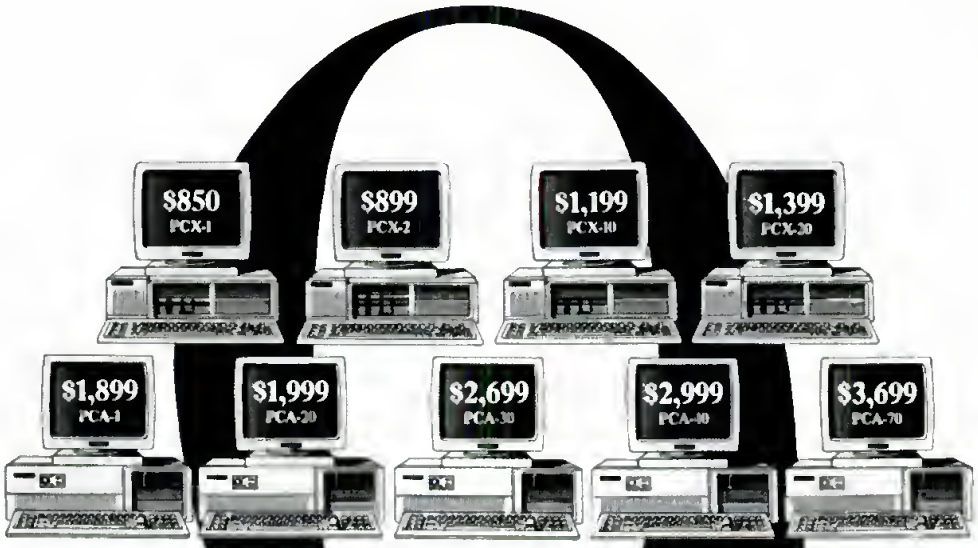

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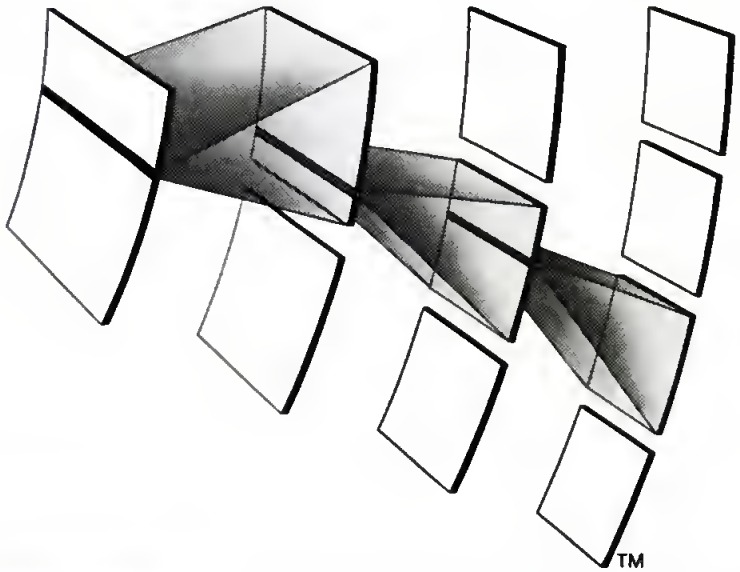

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Nancy Trespasz; Computer Reseller News, April 20, 1987

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Bill Machrone; PC Magazine, December 9, 1986

This is a generic software package that can be adapted to a variety of applications — the limit is only the user's ability and imagination.
Robert Williams; The Bottom Line, April 1986

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TSR DESKTOP ORGANIZERS: MORE FEATURES, FEWER CONFLICTS

RAM-resident desktop organizers have become better behaved and more sophisticated. While their features have branched out from the standard calculator, notepad, calendar, and dialer, serious compatibility problems no longer hamper convenience.

It's been 3 years since Borland's *SideKick* first enchanted users by turning the pop-up utility into what seemed like a panacea for all that ailed the single-tasking PC.

Today, pop-up, RAM-resident, or, more officially, TSR (terminate-and-stay resident) desktop applications give you everything you could ask for from the calculators, calendars, notepads, and dialers offered by the pioneering *SideKick* and PolyTron's *PolyWindows* to the file managers, DOS utilities, programming tools, macro generators, screen-capture utilities, serial communications, and micro-to-host links offered by such packages as Lotus's *Metro*.

TSR desktop organizers like the 14 we look at here

are convenience tools for saving time-consuming steps. With these programs in residence, you can use features that your standalone application doesn't offer—without quitting the application and loading another program. Using a TSR, you simply pop up a window on top of the running application, then jot down a note, calculate figures, update your calendar, or even dial a phone number. When you're done, a single menu choice, keystroke, or keystroke combination will bring you back to the application.

MIXED BLESSINGS With their handy features and ability to hop easily from application to application, it's no wonder that TSR desktop organizers have become so popular and their developers so prolific. But using TSRs hasn't always been as easy and convenient as it should be.

Typical early TSRs worked, at best, most of the time. If you were lucky, when they didn't work, the pop-up application simply wouldn't load and run; if you weren't lucky, it would freeze the computer, dumping unsaved data and forcing a cold boot. The first version of *SideKick*, one of the pioneers if not the first pop-up desktop organizer, was unpredictable. Users discovered compatibility problems with certain applications, such as *XyWrite II*.

We looked at all the problems of RAM residency in depth in *PC Magazine*'s Special Report on RAM Residency ("Taking Up Residence," Volume 5 Number 20). Since then, TSRs have changed for the better; at the same time software developers have been changing nonresident programs to help users take advantage of the TSR proliferation. *SideKick*, for instance, now avoids compatibility problems by demanding to be loaded last. *XyWrite*, which, like *Microsoft Word* and *Samna Word*, uses keyboard interrupts in much the same way TSR programs do, now offers RAM-resident compatibility by allowing you to substitute a more compatible keyboard driver, at the cost of some more-sophisticated *XyWrite* functions.

In addition to becoming more sophisticated and better behaved over the years, pop-up applications offer more bang for the buck. The ones we reviewed range from $25 to $295, but most are in the less-than-$100 range. The original *SideKick* cost $49.95, while competitors like Lotus's *Spotlight* went for $75 as recently as last year. Added features have led to higher price tags, but not a significant amount compared to the increase in value. *Metro*, which has many more features than either the current $84.95 *SideKick* or *Spotlight* (which it replaced), sells for only $85.

While Borland was and is the market standard, others have surpassed *SideKick*'s functionality. The new *SideKick Plus* should make Borland competitive again, but it wasn't available in time to be reviewed for this article.

Another significant change has been that most TSR utilities reviewed for this article are not copy protected (the exceptions are the *Integrated WorkStation* and *Power-Up! One-Key Combo*). Earlier versions of many packages either required you to keep the master floppy disk in the A: drive or to execute a hard disk install utility. Neither of these options was satisfactory. Removing cumbersome copy protection schemes helped TSRs become lighter on their feet, easier to use, and simpler to install.

WHAT THEY OFFER Although the TSR products reviewed here benefit from these improvements, they all share a common heritage in the features offered in the original version of *SideKick*: calculator, notepad, calendar, and dialer—of course, each may implement these differently or offer many extra features.

Here's what you can expect to find offered by the TSR desktop market, as represented by the 14 programs we evaluated:

■ *Calculators*. Calculators are one of the most useful features of a pop-up desktop utility. Many of the programs now available enhance the basic calculator with financial, statistic, or scientific functions in addition to the usual four keys and percent function. Some have running video "tapes" that you can print to get a hard copy record of the calculations. Some calculators even handle decimal-to-hexadecimal and binary conversion.

■ *Notepads and Editors*. Most users report heavy use of their TSR desktop organizer's notepad or text editor. No matter what other word processor you have, an ASCII editor you can access from inside other applications can save not only steps but time, money, and data.

A clipboard feature is an increasingly popular part of TSR editors. The clipboard lets you capture a screen or part of it and copy it to an editor, where you can modify it or write it out to another application. The clipboard is extremely useful for operations like moving spreadsheet numbers into an invoice or financial report and transferring notes into a word processing document, as well as for programmer tasks like documenting programs and tracking and reporting bugs.

■ *Calendars*. Once you use a pop-up calendar, paper desktop calendars seem cumbersome and archaic. Most TSR desktop calendars store a one-line reminder for any time throughout the day, and some attach full-screen or larger notes to each of these hour-by-hour entries. Alarm features on the appointment utilities beep the com-

HOW TSRs WORK

TSR programs generally use built-in DOS interrupts or functions to terminate but stay resident. Generally, you execute the program once from the DOS prompt like any other application. When the program terminates, it executes a routine to make DOS think the program is a part of DOS.

The area of memory occupied by the TSR application is reserved, just as memory is reserved for DOS, so that subsequent applications don't overwrite that section of memory. These utilities look for certain key combinations—Ctrl-Alt, for example—as the signal for regaining control of the computer, suspending the running application, and executing their own instructions.

This process gives the impression that multiple simultaneous tasks are being conducted, but actually only one application is running at a time. When the TSR utility executes, the concurrent application is put on hold until the utility stops operating and tums control over to the original application.

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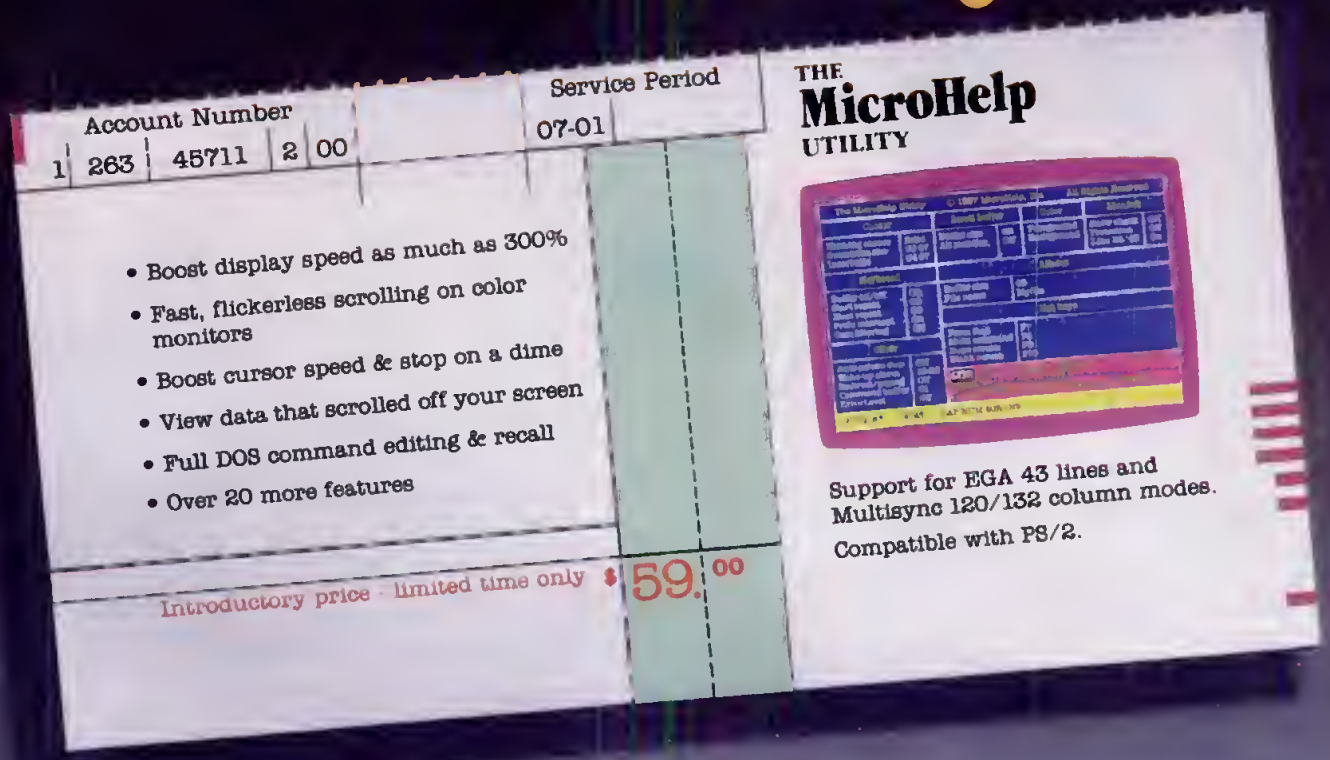

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**With optional EMSdisk module ($50). Requires DOS 3 or later plus either a hard disk, LIM expanded memory or RAM disk in memory beyond 640K. ***BASIC (incl. Mach 2), Turbo Pascal (incl. Mach 2), dBASE II, Assembler

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Desktop Organizers: Summary of Features (continues)

(Products listed in ascending price order)

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List price	$25.00	$49.95	$59.95	$65.00	$69.95	$79.00	$79.00
USER INTERFACE							
Order of loading the program	Variable	Variable	Last	Last	Last	Variable*	First
User-defined screen colors	●	○	●	○	●	●	●
Movable pop-up windows	●	○	●	○	●	●	○
User-defined hot keys	○	○	●	○	●	○	○
Supports installation of individual modules	○	●	●	○	○	●	○
Removable from memory without rebooting	○	○	○	●	●	●	●
DOS INTERFACE							
Directory creation	○	●	○	○	○	●	○
Disk formatting	○	●	○	○	○	●	○
Directory list	●	●	○	○	○	●	●
Delete files	●	●	●	○	●	●	●
Copy files	●	●	●	○	○	●	●
CHKDSK	●	●	○	○	○	●	○
File display (type)	●	●	●	○	○	●	●
ASCII TABLE	●	○	○	●	●	○	○
MACROS							
Learn mode	○	○	○	○	○	○	○
Macros can be edited	○	○	○	○	○	●	○
Compatible with all outside applications	○	○	○	○	○	●	○
Multiple macro files	○	○	○	○	○	●	○

PC—Indicates Editor's Choice ●—Yes ○—No *Must be loaded last if you also wish to unload.

puter's speaker at the appointed time to remind you of a scheduled appointment, even when the appointment screen is not displayed.

■ *Dialers.* Automatic dialers and pop-up communications programs add a level of connectivity and convenience to your operations. When you want to make a call, you search for the appropriate name or company in your database of personal or business contacts or in your phone directory. With the proper record displayed on the screen, you pop up the dialer, and it calls the number automatically from the screen display.

■ *DOS Utilities.* Pop-up DOS utilities can be invaluable. How many times have you tried to save a new data file to a floppy disk, only to discover that the floppy disk is unformatted? With TSR DOS access, you can suspend the running application, access the DOS format utility, and return to the original application without losing any data.

■ *ASCII Tables.* Programmers, as well as users who need to send escape codes to their printers, need to know both the ASCII and hexadecimal representations of the PC character set. If this information pops up right on-screen, it's one less chart to paste next to the wall.

■ *And More.* Some TSR packages even include a fairly sophisticated and functional database program to help you keep necessary names, addresses, and telephone numbers at your fingertips, right in memory. Also available in some packages are programming tools, macro generators, lock-up features, serial communications, encryption/decryption options, and micro-to-host links.

As desktop organizer programs go upscale and add more features, they begin to resemble the low end of integrated software. Once a notepad adds page offsets, perf skips, boldfacing, and underlining, it's a word processor. Likewise, a card file you can sort or mask and print only some of the fields becomes a minidatabase. The trade-off: they need more memory, or only the kernel remains resident and the applications must load from disk.

THE MEMORY CONSIDERATION

Most people actually need and want to use only a few of the many features the new TSR desktop organizers offer. In order to attract new users, program developers are now trying to pack their products with as many of these features as possible, but loading in added features ties up large chunks of valuable RAM.

Contributing to the RAM overhead problem is the fact that TSR desktop organizers have been joined in the fight for RAM residency by other types of programs in the TSR world: thesauri, spelling checkers, memory managers, *1-2-3* utilities, keyboard enhancers, background communications, and more. A combination of software utilities that seem necessary in the abstract may become a high-cost option when you consider the amount of RAM required.

As a result, when choosing a TSR desktop organizer, you'll not only want to find the one that offers the most features, you'll want to assess how much memory you're willing to dedicate to the TSR.

The best TSR for your needs may perform only a few functions, as long as they're functions you use daily and can't get from your other applications.

But if you really need lots of features, you have another alternative. The TSRs reviewed here use memory in different ways. Some load all the desktop organizer options in memory at startup, maximizing their access speed; but others load only a kernel, or shell, program that calls up disk

	PolyWindows DeskPlus	SideKick	Metro	HomeBase	WordPerfect Library	Pop-Up DeskSet Plus	Integrated WorkStation
List price	$84.95	$84.95	$85.00	$89.95	$129.00	$129.95	$295.00
USER INTERFACE							
Order of loading the program	Last	Last	Variable	Last	Last	Variable	Not specified
User-defined screen colors	●	●	●	●	●	●	●
Movable pop-up windows	●	●	●	○	●	●	○
User-defined hot keys	●	●	●	●	○	●	○
Supports installation of individual modules	●	●	●	●	●	●	○
Removable from memory without rebooting	●	●	○	○	○	○	○
DOS INTERFACE							
Directory creation	●	○	●	○	●	○	●
Disk formatting	○	○	●	○	○	○	●
Directory list	●	○	●	●	○	●	●
Delete files	●	○	●	●	●	●	●
Copy files	○	○	●	●	●	●	●
CHKDSK	●	○	●	○	○	●	●
File display (type)	●	○	●	●	●	●	●
ASCII TABLE	●	●	●	○	○	○	○ (partial)
MACROS							
Learn mode	○	○	●	○	●	○	○
Macros can be edited	○	○	●	○	●	○	○
Compatible with all outside applications	●	○	●	○	●	○	○
Multiple macro files	●	○	●	○	●	○	○

overlay files, which you can store separately on your hard disk to save precious RAM. With a program using the latter approach to memory, you can experiment with the available features of the package you have chosen, decide which features you use most consistently, and forget the rest for everyday use.

Some packages also allow you to remove any TSR utility from memory as it becomes necessary. You'll probably want to install a TSR program you use regularly by using program install commands in an AUTOEXEC.BAT file. But you also need to be able to remove specific modules of the package when you want to use applications that interfere with the TSR or that need more memory than you have available with the TSR loaded. A package that forces you to reboot to free up memory can be both inconvenient and irritating.

If you juggle several TSRs, consider a TSR manager such as *Referee* ($69.95, from Persoft, Madison, Wisconsin) and *PopDrop* ($19.95, from InfoStructures, Tucson, Arizona). They allow you to drop a TSR utility from memory even if it's not the last one loaded. For more information, see "Taking Up Residence," Volume 5 Number 20.

INTERFACES AND DISPLAYS When choosing a TSR desktop organizer, you'll also want to consider the program's interface methods and screen displays. Some of the programs use pop-down menus with English-language options; you select the options by moving the cursor and hitting Return or a designated function key. This interface method makes the program easier to learn and at first easier to use. Other programs use an Alt–"hot key" approach, which some users find faster and more convenient.

The on-screen appearance of the organizers can also be an important consideration. Some TSR calculators, for example, actually look like a standard calculator, even with a "tape" that scrolls toward the top of the screen. Others bear no resemblance to an actual calculator; they just do the same job. Also, some programs let you overlay windows to see more than one module at a time, the calendar along with the notepad, for example. Others clear the screen each time you call up another module. Detailed graphics and multiple-window systems make it easy to compare data, but they may cause you to sacrifice speed.

The TSR utilities we tested are generally well-behaved and work fine with most standard applications. But you may have to experiment with the installation sequence if you are using more than one TSR utility—a thesaurus, a keyboard enhancer, and a desktop organizer, for example.

Some TSRs demand that you install them immediately after DOS because they don't check for non-DOS software before deciding where to position themselves in memory. Others, such as network drivers, frequently must be installed last to function properly. If you have difficulty running a TSR with certain software applications, try changing the order in which you load the programs.

ONGOING SEARCH Basically, the proliferation of TSRs like these desktop organizers reflects an intensified search for multitasking capabilities. Multitasking, partitioning, and operating environments like *DESQview* address the issue of multiple applications running concurrently. *Windows*, *GEM Desktop*, and *Top View* offer possible solutions, but these environments are guilty of some of the same offenses against DOS as TSRs are.

As memory sizes grow, CPUs become more powerful, and new versions of DOS are introduced, running concurrent appli-

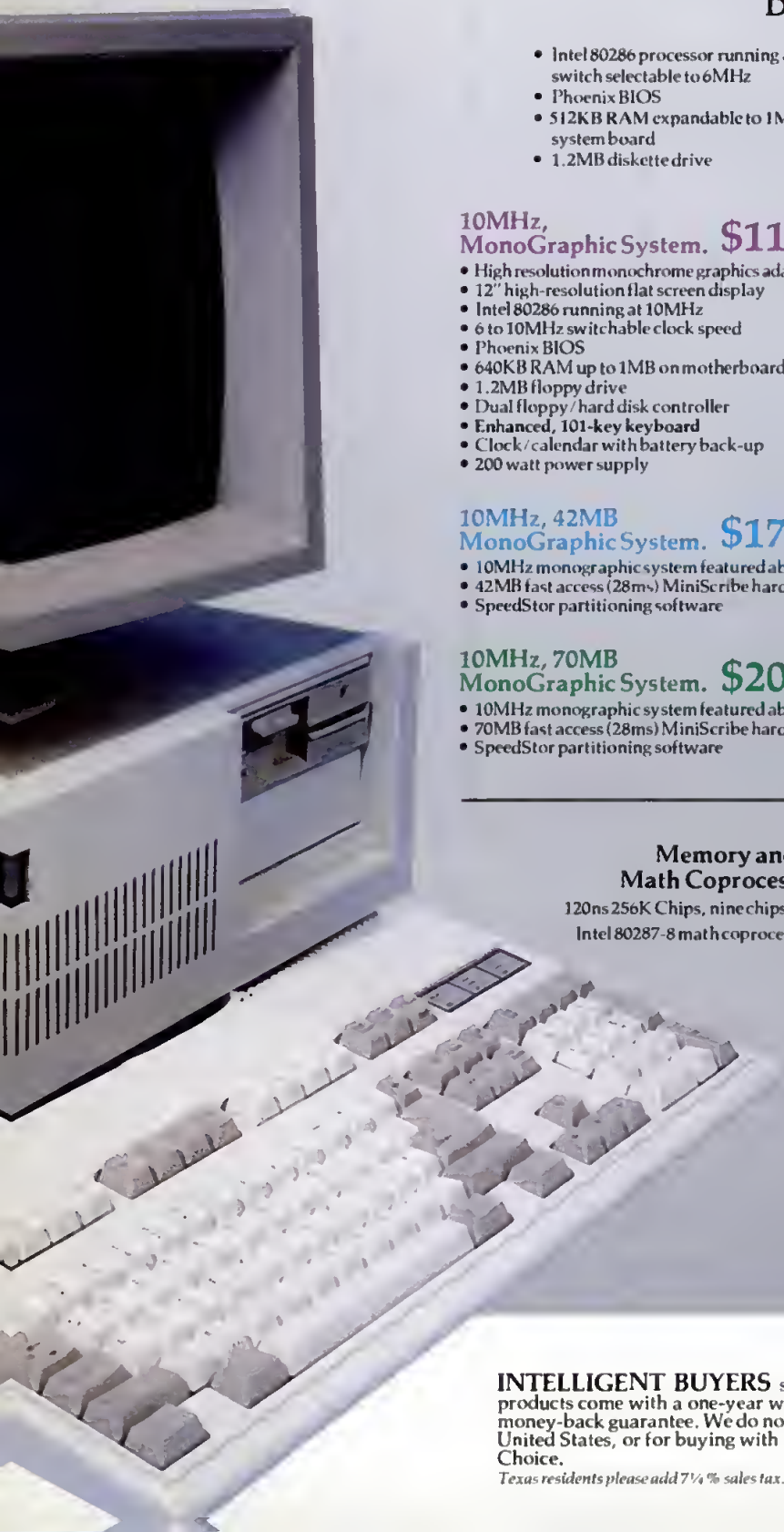
IMS-286

10 MEGAHERTZ

$999

Base System

- Intel 80286 processor running at 10MHz, switch selectable to 6MHz
- Phoenix BIOS
- 512KB RAM expandable to 1MB on system board
- 1.2MB diskette drive
- Dual diskette drive/fixed disk controller
- **Enhanced, 101-key keyboard**
- Clock-calendar with battery backup
- 200-watt power supply
- Illustrated installation and operations manual



10MHz, MonoGraphic System. $1199

- High resolution monochrome graphics adapter card
- 12" high-resolution flat screen display
- Intel 80286 running at 10MHz
- 6 to 10MHz switchable clock speed
- Phoenix BIOS
- 640KB RAM up to 1MB on motherboard
- 1.2MB floppy drive
- Dual floppy/hard disk controller
- **Enhanced, 101-key keyboard**
- Clock/calendar with battery back-up
- 200 watt power supply

10MHz, EGA Color System. $1599

- Enhanced graphics adapter video card
- 14" high resolution EGA color monitor
- Intel 80286 running at 10MHz
- 6 to 10MHz switchable clock speed
- Phoenix BIOS
- 640KB RAM up to 1MB on motherboard
- 1.2MB floppy drive
- Dual floppy/hard disk controller
- **Enhanced, 101-key keyboard**
- Clock/calendar with battery back-up
- 200 watt power supply

10MHz, 42MB MonoGraphic System. $1799

- 10MHz monographic system featured above, plus:
- 42MB fast access (28ms) MiniScribe hard disk
- SpeedStor partitioning software

10MHz, 42MB EGA Color System. $2199

- EGA color system featured above, plus:
- 42MB fast access (28ms) MiniScribe hard disk
- SpeedStor partitioning software

10MHz, 70MB MonoGraphic System. $2099

- 10MHz monographic system featured above, plus:
- 70MB fast access (28ms) MiniScribe hard disk
- SpeedStor partitioning software

10MHz, 70MB EGA Color System. $2499

- EGA color system featured above, plus:
- 70MB fast access (28ms) MiniScribe hard disk
- SpeedStor partitioning software

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120ns 256K Chips, nine chips per set.. $35

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- AT-style keyboard
- 150-watt power supply
- Illustrated installation and operations manual

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- High resolution monochrome graphics adapter card
- 12" high-resolution, flat screen display
- Intel 8088-1 processor running at 10MHz
- 6 to 10MHz switchable clock speed
- 640KB RAM
- 360KB floppy drive
- Floppy disk controller
- AT-style keyboard
- 150-watt power supply

10MHz, EGA Color System. $1099

- Enhanced graphics adapter video card
- 14" high-resolution, EGA color monitor
- Intel 8088-1 processor running at 10MHz
- 6 to 10MHz switchable clock speed
- 640KB RAM
- 360KB floppy drive
- Floppy disk controller
- AT-style keyboard
- 150-watt power supply

10MHz, 20MB MonoGraphic System. $989

- Same monographic system featured above, plus:
- Reliable 20MB MiniScribe hard disk system with Western Digital controller

10MHz, 20MB EGA Color System. $1389

- Same EGA color system featured above, plus:
- Reliable 20MB MiniScribe hard disk system with Western Digital controller

10MHz, 30MB MonoGraphic System. $1039

- Same monographic system featured above, plus:
- Reliable 30MB MiniScribe hard disk system with Western Digital RLL controller

10MHz, 30MB EGA Color System. $1439

- Same EGA color system featured above, plus:
- Reliable 30MB MiniScribe hard disk system with Western Digital RLL controller

---

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360KB floppy drive to enhance your IMS-88...$99

PC I/O Board

Serial port, parallel port, game port.. $69

PC Multifunction Board

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Desktop Organizers: Summary of Features (continued)

(Products listed in ascending price order)

	PC-DeskTeam	Power-Up! One-Key Combo	Partner-PC	TeamWork	Perks-PC	HQ	PC-Desk
CALCULATOR							
Percent	●	●	●	●	○	●	○
Financial functions	○	○	●	○	○	○	○
Scientific functions	○	○	○	●	○	○	○
Number base conversion	○	○	○	○	●	○	○
Single memory	○	●	●	○	●	●	●
Multiple memories	○	●	○	○	○	●	○
On-screen tape	●	●	●	●	○	●	●
Printing capability	●	●	●	●	○	●	●
Screen capture	●	○	●	○	○	○	○
Exports values	●	●	●	●	●	●	○
NOTEPAD							
Variable screen size	○	○	●	●	●	○	○
Variable document size	○	○	●	●	●	●	○
User-defined command keys	○	○	○	○	○	●	○
Enhanced text							
Bold	○	○	○	○	○	○	●
Underline	○	○	○	○	○	○	●
Extended ASCII	○	○	○	○	○	○	○
Emphasized	○	○	○	○	○	○	○
Top and bottom margins	○	○	○	○	○	○	○
Block operations							
Move	○	○	●	●	●	●	●
Copy	○	○	●	●	●	●	●
Delete	○	○	●	●	●	○	●
Find	○	○	●	●	●	●	●
Search and replace	○	○	●	●	●	●	○
Mail-merge capabilities	○	○	○	○	○	○	●
Imports/exports ASCII files	●	●	●	●	●	●	●
Screen capture	○	○	●	○	●	○	○
PHONE DIALER							
Auto-dial	●	○	●	●	●	●	●
On-screen number capture	●	○	●	●	●	○	○
Separate phone directory	●	○	●	○	○	●	●
Phone directory holds full names and addresses	○	○	●	○	○	●	●
User-defined lead-in numbers	●	○	●	●	○	●	●
Strips local area code	●	○	○	○	○	○	○
TELECOMMUNICATIONS							
Background call/answer	○	○	○	○	○	○	○
File transfer	○	○	○	○	●	○	○
Auto-log-on scripts	○	○	○	○	○	○	○
CALENDAR/APPOINTMENT SCHEDULER							
Max. no. of characters per description	Unlimited	22	15†	None	Unlimited	Unlimited	Unlimited
User-defined times	●	●	●	○	○	●	●
Multiple calendar/appointment files	●	●	●	●	○	●	○
Alarm function	●	●	●	○	●	●	●
Weekly/monthly schedules (one entry schedules appointment for same day of each week or month)	○	○	●	○	○	○	○
Separate clock/stopwatch	●	●	●	○	○	○	○
"To do" lists	○	○	○	○	○	○	●
DATABASE/FILER							
User-configureble file structure	○	○	○	○	○	●	○
Name and address files	○	○	○	○	●	○	●
Interfaces with auto-dialer	○	○	○	●	●	○	●
dBASE III compatible	○	○	○	○	○	○	○
Import/exports							
ASCII (in columns)	○	○	○	○	○	○	○
ASCII (comma delimited)	○	○	○	○	○	○	○
.DBF	○	○	○	○	○	○	○
.DIF	○	○	○	○	○	○	○

PC—Indicates Editor's Choice. ●—Yes ○—No †Appointment scheduler in notepad allows 80 characters.

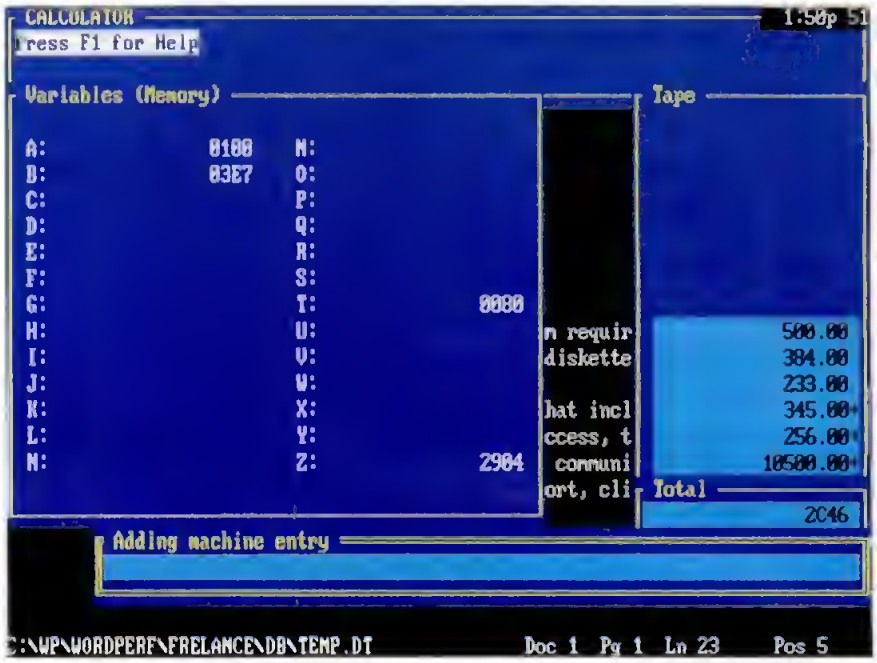
	PolyWindows DeskPlus	SideKick	Metro	HomeBase	WordPerfect Library	Pop-Up DeskSet Plus	Integrated WorkStation
CALCULATOR							
Percent	●	○	●	○	●	●	○
Financial functions	○	○	●	○	●	●	○
Scientific functions	●	○	○	○	●	●	○
Number base conversion	●	●	○	●	●	○	○
Single memory	●	●	●	●	●	●	●
Multiple memories	○	○	●	●	○	●	○
On-screen tape	●	○	○	●	●	●	●
Printing capability	●	○	○	●	●	●	●
Screen capture	○	○	○	●	○	○	○
Exports values	●	●	●	●	●	●	●
NOTEPAD							
Variable screen size	●	●	○	○	○	●	●
Variable document size	●	●	●	○	○	●	●
User-defined command keys	●	●	○	○	●	○	○
Enhanced text							
Bold	○	○	○	○	○	○	○
Underline	○	○	○	○	○	○	○
Extended ASCII	○	●	○	○	○	○	●
Emphasized	○	○	○	○	○	○	○
Top and bottom margins	○	○	○	○	○	○	○
Block operations							
Move	●	●	●	●	○	●	○
Copy	●	●	●	●	○	●	●
Delete	●	●	●	●	○	●	●
Find	●	●	●	●	●	●	●
Search and replace	●	●	○	●	●	●	●
Mail-merge capabilities	○	○	○	○	○	○	○
Imports/exports ASCII files	●	●	●	●	○	●	●
Screen capture	○	●	●	●	○	●	●
PHONE DIALER							
Auto-dial	●	●	●	●	●	●	●
On-screen number capture	●	●	○	●	○	●	○
Separate phone directory	○	●	●	●	●	●	●
Phone directory holds full names and addresses	○	●	●	○	●	●	●
User-defined lead-in numbers	○	●	●	●	●	●	●
Strips local area code	○	○	○	○	○	●	●
TELECOMMUNICATIONS							
Background call/answer	○	○	○	●	○	○	○
File transfer	○	○	○	●	○	●	○
Auto-log-on scripts	○	○	○	○	○	●	○
CALENDAR/APPOINTMENT SCHEDULER							
Max. no. of characters per description	43	26	34	Unlimited	255	Unlimited	58
User-defined times	●	○	●	●	●	●	●
Multiple calendar/appointment files	●	●	●	●	●	●	○
Alarm function	●	○	●	●	●	●	●
Weekly/monthly schedules (one entry schedules appointment for same day of each week or month)	○	○	●	○	○	○	○
Separate clock/stopwatch	○	○	●	●	●	●	○
"To do" lists	○	○	●	●	●	○	○
DATABASE/FILER							
User-configurable file structure	●	○	○	●	●	○	○
Name and address files	●	○	○	●	●	○	●
Interfaces with auto-dialer	●	○	○	●	●	○	●
dBASE III compatible	○	○	○	○	○	○	○
Import/exports							
ASCII (in columns)	○	○	○	●	○	○	○
ASCII (comma delimited)	○	○	○	○	○	○	○
.DBF	○	○	○	○	○	○	○
.DIF	○	○	○	○	○	○	○

cations may become practical. No one yet knows what the new IBM OS/2 will mean for the TSR world. Perhaps TSR programs will no longer be necessary or even possible with new applications running under a multitasking version of DOS.

Lotus and Borland both are working on applications program interfaces (APIs) that serve as tiny operating systems and rule-enforcers for TSRs. Either the Borland or the Lotus API would do the windowing and disk writes for the other TSRs, and, to the extent that other TSRs obey the master TSR, would end TSR conflicts.

In the meantime, TSR desktop organizers like the ones we review below, which are listed in alphabetical order by product name, are enhancing traditional single-user, single-tasking installations.

—Tom Badgett



The HomeBase *calculator offers features that are rare, even in programmable hand-held calculators. For instance, you can modify many functions by typing commands at the prompt line. Here we converted decimal numbers to hex by typing HEX at the prompt.*

HomeBase

Brown Bag Software's *HomeBase* is a menu-driven, user-definable desktop utility, packed full of features for a reasonable $89.95. Offering both novice and power users the features and functionality they need, *HomeBase* includes a programmable calculator, a full-screen editor with clipboard, a DOS interface, a free-form and template-driven database, a calendar with clock, and a communications utility featuring Xmodem file transfer and background e-mail support.

HomeBase installs and runs with most hardware configurations, and it also allows you to set a number of functions and configurations by toggling "switches" on the command lines that invoke the package—a valuable feature. Examples of *HomeBase*'s user-definable functions include setting the features you want to be standard, the hot keys, and the colors of the pop-up windows.

Although the *HomeBase* calculator takes a little getting used to, it offers features and functions that are rare, even in programmable hand-held calculators. For one thing, you can establish up to 26 numeric variables (for example, a = 133) to use in your calculations instead of the numeric literals.

Since the calculator is command driven, you can modify many functions by typing a short command sequence at the prompt line. To convert a displayed decimal number to hex, for example, you simply type HEX at the prompt. The command DEC switches the displayed number back to decimal.

HomeBase uses the features of its notepad/editor in several applications, including "notebase," a flexible database filer that supports free-form data as well as template-driven input screens. Using the template feature, you can establish screen overlays to format data into a name and address file, for example, or a business expense file. You can design virtually any convenient record template to organize notebase data.

The full-screen editor is easy to learn and use. The Home, End, and cursor movement keys operate in the standard way, to jump to the beginning of a line and to the top and bottom of a document. On-screen menus support such functions as Load and Save a file, while *WordStar*-compatible commands conduct block and cursor movement operations.

Despite the power of *HomeBase*, we experienced some annoying problems. The installation program failed to copy two menu overlay files into the *HomeBase* directory on the hard disk. Blank pop-up windows were the result, making it impossible to tell which functions were being selected. The manufacturer identified the problem, though, and after the required

PC MAGAZINE FACT FILE

***HomeBase*, Version 2.5**
Brown Bag Software
2155 S. Bascom Ave.
#114
Campbell, CA 95008
(800) 523-0764
(800) 323-5335 (in Calif.)

List Price: $89.95

Requires: 80K RAM beyond other system requirements, two disk drives (hard disk recommended), DOS 2.0 or later.

In Short: A menu-driven TSR utility that offers many features, including a sophisticated programmable calculator, full-screen editor, and database, with the ease of use that novice users prefer and the customizing options that power users demand. Not copy protected.

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PC 887

files were copied into the hard disk subdirectory, *HomeBase* functioned normally. Another area for improvement is the way *HomeBase* handles error conditions: when something goes awry, it's less than enlightening, displaying only the terse "Press space bar to continue . . ." message.

HomeBase has a lot to offer, even though it may require a little tweaking until you're completely satisfied. If your operations are of the "load and run" variety, a simpler program may be a better choice. But if you need the wide range of functionality *HomeBase* offers, if you appreciate extensive control and user-definable features, and you like Lotus-style menus, then *HomeBase* is well worth considering.—**Tom Badgett**

HQ

TEK Microsystems has created one of the more full-featured of all the desktop organizers: *HQ*. The $79 program includes a macro editor, a notepad, a calculator, a card-file organizer, an appointment book, a phone book with dialer feature, a DOS window, and a LockUp function. *HQ* uses memory relatively efficiently. If 92K bytes are available, any of the applications can run; if more, you may use several simultaneously.

The program's context-sensitive help system comes in handy, and its help screens that accompany error messages are useful when something goes awry. Plus, *HQ* has many helpful features that make some common problems less likely; for example, like *1-2-3*, it lets you type a disk or pathname and select from a file list in appropriate places (all the more impressive when you realize that Lotus's own *Metro* doesn't have this capability).

HQ's QuickKey option is a full-featured editor for macros. Going beyond assigning macros to keystrokes, it lets you put macros on menus easily and assign their "context" (in particular applications, DOS, *HQ* itself, or "everywhere"). When you invoke QuickKey, *HQ* displays a list of available macros. A learn mode helps out when you forget the keystroke assignments, and you can protect your macros. You can also play them back in several different ways, including single-step, and *HQ* permits you to nest them.

HQ is one of the more full-featured desktop organizers. Its adequate calculator, shown here, performs four-function math. It also lets you switch between normal algebraic mode and Reverse Polish Notation, show and print tapes, and export data easily.

The program supports prompting for responses, with or without default responses included, and the command language includes looping, wait-untils, and variable pauses. A direct conversion to *1-2-3* format is available, and "menu macros" invoke menus whose macros may themselves call other menus. QuickKey is alone more than worth *HQ*'s $79 price.

The well-designed appointment book displays the calendar and appointments on the same screen and allows you to zoom in and out on the intervals or set an appointment for, say 7:23. Like the other applications, the appointment book has a Lotus-like menu at top that responds to the first letter of commands as well as "point-and-shoot" style. A string search feature is available to search everything listed, and you can have multiple appointment books. *HQ* supports alarms as well.

HQ's adequate calculator performs typical four-function math, and you can switch it into normal algebraic mode or Reverse Polish Notation (RPN) as required. You can show and print a tape as well as export data easily.

The NotePad offers word wrap and a built-in memo header; other than that, it's quite standard. The Organizer, a card-style relational table manager, can categorize cards and perform operations based on that category with the Limit command.

The Phone Book is organized properly, a rarity among these products. It displays a

PC MAGAZINE FACT FILE

HQ
TEK Microsystems Inc.
2067 Massachusetts Ave.
Cambridge, MA 02140
(617) 497-1200
List Price: $79
Requires: 92K RAM in addition to other system requirements, one floppy disk drive (hard disk recommended), DOS 2.0 or later, Hayes or Hayes-compatible modem for auto-dial feature.
In Short: An impressive, full-featured program that is one of the best values in the TSR desktop organizer market today. Not copy protected.

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CIRCLE 144 ON READER SERVICE CARD

list on the left of the screen, with the highlighted entry shown in a window on the right in detail. A field is provided for phone numbers, and a Dial command works without your having to put the cursor anywhere special. Find and Limit operations are permitted, and you can generate printed copies of the cards, a Directory, or labels from the database.

The Disk Manager is your DOS window, allowing you to list directories, sorted, if desired, by several options, to change and make directories, to type files, and so forth. It includes a Locate command that finds files anywhere on the disk, and it also permits you to export a file to another *HQ* module or application program by using the Shift-Alt-Backslash key combination.

HQ's password-based LockUp function locks your information away from interlopers. It works fine unless you turn the machine off and on again (nothing will help under that scenario) or copy the appropriate module over from a floppy disk and reset it (and that's handy if you ever forget your own password).

With so much to offer, *HQ* is one of the best values in the TSR desktop organizer market.—**Merv Adrian**

The Integrated WorkStation*'s Directory Processing is a full-screen file management system that, among other things, allows you to access the contents of a subdirectory and execute .COM or .EXE files by highlighting them and pressing Enter. The calculator is a basic four-function model.*

Integrated WorkStation

The *Integrated WorkStation* (*IWS*), a $295 package from XYZT Computer Dimensions, is one of the finest TSR packages I've seen. Unfortunately, *IWS* still clings stubbornly to the old-style INSTALL/UNINSTALL form of copy protection.

IWS's main menu permits you to create submenus and assumes you want the basic PC functions readily available: database, word processing, and spreadsheet. Choosing these functions requires using submenus, but you can change the menus and remove the entries or set them to invoke the three basic functions or any other applications. DOS functions are also directly available from this main menu, and not in the resident piece.

But given the extras, you'll probably find it very worthwhile to use the menu to access some of them. The DOS FORMAT command, for example, is interactive here; it prompts you for sector count, whether you want the system on the disk, and so forth. The interactive BACKUP and RESTORE capabilities are perhaps the biggest boon in DOS functions.

Another main menu option, Phone Utilities/Quick Letter, also adds its own twists to some common tools. Quick Letter, if invoked from the phone list function, will create a template business letter automatically, with the addressee (the one you had selected in the Phone List) filled in, the date included, and your name appended in closing. The Phone List itself supports dialing, report or label output formats, sorting on any field, screening conditions for lists (State = NY), and FIND functions on the first letter followed by point-and-shoot (if you type in J, for example, you see all the Js; you then highlight the one you want and press Enter for the detail record). You can also use Find to locate unique substrings.

IWS's reminder function gives you an attractive added feature: even though you've already seen the reminder, a function key lets you see it again every time you ask. Directory Processing is a full-screen file management system with its own nice touches. To see the contents of a subdirectory, for example, you simply highlight it and press Enter, and to execute a .COM or .EXE file, you do likewise and get a set of choices, one of which is execution. If the file is obviously textual in nature, *IWS* gives you different choices, including print and list. The program's well-thought-out print function will queue

PC MAGAZINE FACT FILE

IWS

Integrated WorkStation (IWS)
XYZT Computer Dimensions Inc.
150 Broadway, #504
New York, NY 10038
(212) 608-6655
List Price: $295

Requires: 150K RAM beyond other system requirements, hard disk, DOS 2.1 or later, Hayes or Hayes-compatible modem for auto-dial feature.

In Short: Two products in one: a nonresident menu and file-handling package and a comprehensive set of resident utilities called Breakthrough. Copy protected.

CIRCLE 672 ON READER SERVICE CARD

requests if the printer is unavailable.

All these options and more are the benefits of using *IWS* if you're willing to operate under the menu system. In addition, a password protects the whole system and allows you to lock the machine up if you need to walk away for a while. Another password protects the supervisory functions, which let you adjust the parameters of the system.

RESIDENT BREAKTHROUGH The TSR menu, Breakthrough, is a standard tool set, accessed by using Ctrl-Alt. Like the rest of *IWS*, it's unusually well conceived and executed.

The calculator is a basic four-function model with a "tape," memory, squares, and square roots. One truly innovative feature is Breakthrough's ability to put text on the tape output.

The calendar, which you page via the PgUp and PgDn keys, highlights holidays and disappears to reveal the appointments calendar for the day selected. You can enter both appointments and reminders, and you can toggle the clock on and off.

A card file, which uses the same database that the phone list is based on, appears as needed in list or detail format; you may also dial from it. The list uses the point-and-shoot technique; once the detail card is displayed, you can use a function key to do the trick.

IWS's 132-character-wide scratch pad has a submenu with more outstanding innovations, including a graphics help subfunction that shows you all the characters in the extended graphics set with the Alt-key combinations on the numeric keypad, the ability to do line and box drawing as a result, and other useful additions. From this menu you can find and replace, print or queue to printer, perform block and column functions including color setting, and more. The many customizable parts of *IWS* include not only the passwords but also the DOS prompt you get when you exit. You may also customize your printer codes and set up hardware options with the modem.

IWS brings a fresh and carefully considered approach to nearly everything but copy protection. Nevertheless, it's an innovative, full-featured program with a lot to offer.—**Merv Adrian**

Metro

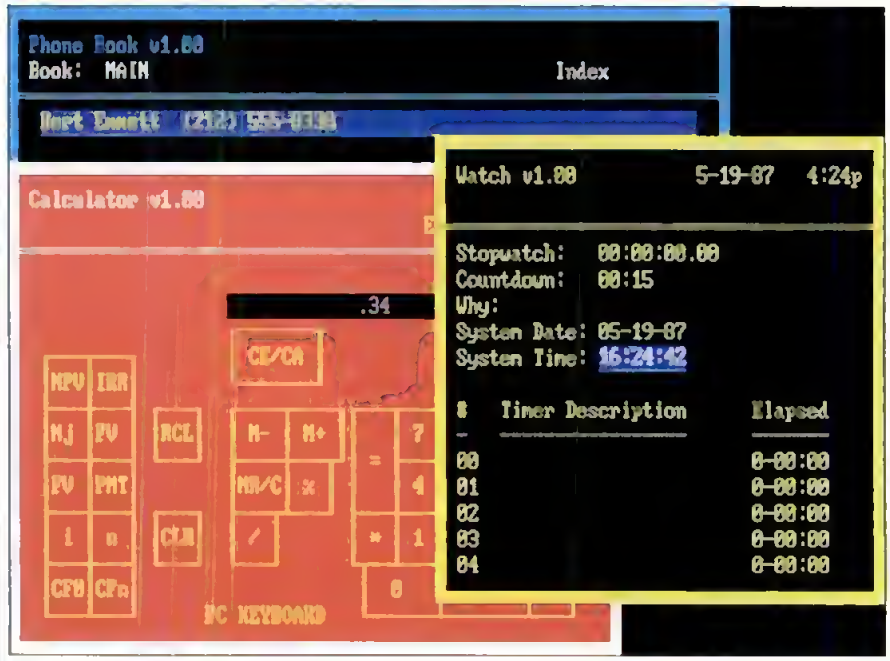
Metro, the most complex and full-featured of the desktop utilities we reviewed, is Lotus Development Corp.'s $85 replacement for its *Spotlight* utility, with compatible data files and instructions for converting *Spotlight* data to *Metro* files. *Metro* is not *Spotlight* with a new name; it offers more, most notably a word processor and a macro feature.

Metro includes the usual calculator, notepad, dialer, appointment book, and ASCII table, but in addition, *Metro* offers a separate word processor that has a lot of the features you would expect in a standalone package. A clipboard transfers material among the various *Metro* applications or between *Metro* and outside applications such as spreadsheets and word processors.

Metro also includes a time manager with a countdown timer and a stopwatch to track time spent on up to 99 separate projects. And *Metro*'s list manager handles any kind of date-oriented, single-line list or reminder. A note attachment feature lets you link a full screen of text to any list item, and section headings group lists under appropriate topics. A filer function lets you access such DOS-level functions as directory displays, file copy, rename, and delete, and floppy disk format. These features come in handy when you're inside a running application but have forgotten to create the proper subdirectories or to format a floppy disk. Finally, *Metro*'s macro feature supports keyboard and programming macros.

1-2-3 CONNECTION *Metro* has the look and feel of Lotus's *1-2-3*. Each separate application has its own *1-2-3*–like menu that makes learning this package relatively easy for experienced *1-2-3* users.

But with so many features, *Metro* keeps only a shell in RAM. Lotus specifies that *Metro* requires a minimum of 80K bytes of RAM, but you must reserve at least 120K bytes of RAM if you want to use all this package has to offer. You can specify between 80K and 512K bytes from the *Metro* configuration screen so that more applications can be loaded concurrently. Unfortunately, once you exit an application, it is removed from RAM and must be loaded from disk when you call it again. Moreover, keeping all of *Metro* at your fingertips at all times requires 438K bytes of disk



Metro's unique time manager with countdown timer and stopwatch lets you track time spent on up to 99 separate projects. A business-oriented programmable calendar and phone directory are also part of this full-featured package.

space, and as you use the editor, notepad, and other applications, automatic files are created that use additional space.

You wouldn't want to run *Metro* from a floppy disk drive, although according to the documentation this is an acceptable configuration. Too much disk I/O is required during operation, and the program requires too much storage to make floppy operation feasible. In addition, when run from a floppy drive, even on a high-performance machine, *Metro* is simply too slow to be practical.

Metro's calculator functions as a business-oriented programmable calculator with built-in programs for several financial calculations, including payment on a loan, interest, and future value. Values can be added or subtracted from a calculator memory to handle temporary or interim values. Unlike *SideKick*'s calculator, *Metro*'s calculator does not support number base conversion. The *Metro* clipboard can transfer calculator values to other applications.

Metro's phone directory is more versatile than *SideKick*'s, supporting multiple display formats and a labeling function. You can use the phone directory to dial numbers with an intelligent modem, and you can print mailing labels from the phone directory database.

The notepad editor can store up to eight pages of text, with 14 lines on each page. Automatic line wrap is enabled within each page, but you must use PgDn or PgUp to flip pages. The editor supports many more features than the notepad, offering block operations, enhanced text characteristics, and print operations. The amount of RAM available limits editor file size.

Metro's easy-to-use, menu-driven macro facility works like *ProKey* or other keyboard macro–generating programs. A learn mode stores DOS or application keystrokes in a form similar to that of *1-2-3*, Release 2. Alphabetic and numeric keys are stored normally, while function keys or other special keys are surrounded by curly brackets. Macros are stored in user-defined disk files. Although only one macro file can be active at a time, the number of macros you can store by switching files is limited only by disk space. And you can use the same key combinations to perform different tasks in different applications.

■ *Metro*'s phone directory is more versatile than *SideKick*'s, supporting multiple display formats and a labeling function.

The macro facility includes a one-line description of each macro and an edit feature to permit you to fine-tune the macros after you have entered them with the "learn" mode. In the learn mode, *Metro* issues a low-pitched beep with each keystroke to remind you that each keystroke is being stored for playback later. You can program in delays or tell the macro to pause for variable input from the keyboard.

A built-in macro editor permits you to modify macros after the initial generation with the learn mode. If a conflict arises between an existing macro and another application, you can disable *Metro* macros temporarily.

Metro is a useful utility with easy-to-learn features. Unfortunately, it conflicts with some other TSR packages, including *Repeat Performance*, the keyboard speed-up utility. *Metro* works fine with *SideKick*, however, easing the transition from one desktop accessory to the other. And we experienced no problems using *Metro* with Novell's *S/Net* network driver software. If you use *1-2-3* frequently, you'll want to consider this many-featured TSR.

—Tom Badgett

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Metro
Lotus Development Corp.
55 Cambridge Pkwy.
Cambridge, MA 02142
(617) 577-8500
List Price: $85
Requires: 120K RAM beyond other system requirements, two disk drives or hard disk, DOS 2.0 or later.
In Short: TSR utility that supports many business and productivity tools, including clipboard to move data among various applications; uses *1-2-3* command structure and menus and supports keyboard macros. Not copy protected.

CIRCLE 671 ON READER SERVICE CARD

Partner-PC

It came as no surprise that *Partner-PC*'s packaging and approach are thoroughly professional. The $59.95 program is a product of TimeWorks, which publishes a number of programs aimed at serious-minded business people; among these programs are the Sylvia Porter financial software and the Evelyn Wood reading course.

Partner-PC's professional orientation shows immediately in the list of available tools. Calculator, name and address list, phone dialer, alarm clock with hourly chime and adjustable on-screen display, memo pad—they won't disappoint you. The desktop accessories *Partner-PC* offers are carefully thought out in terms of function, and in several areas they are as good as any on the market. Unfortunately, the program's interface needs a little work; it lacks a main menu to pull it all together,

PC MAGAZINE FACT FILE

Partner-PC
TimeWorks Inc.
444 Lake Cook Rd.
Deerfield, IL 60015
(312) 948-9200
List Price: $59.95
Requires: 16K RAM beyond other system requirements, one disk drive, DOS 2.0 or later, Hayes or Hayes-compatible modem for auto-dial feature.
In Short: A professional TSR utility with outstanding calculator, but it lacks a main menu to pull everything together. Not copy protected.

CIRCLE 670 ON READER SERVICE CARD

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System requirements

IBM PC, AT, XT, PS/2, Portable, 3270 or true compatibles. PC-DOS (MS-DOS) 2.0 and later. 384K.

How to use Eureka: The Solver

It's easy.

1. Enter your equation into the full-screen editor
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- Plot a graph
- Generate a report, then send the output to your printer, disk file or screen
- Or all of the above

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- ☑ Pull-down menus
- ☑ Context-sensitive Help
- ☑ On-screen calculator
- ☑ Automatic 8087 math co-processor chip support
- ☑ Powerful financial functions
- ☑ Built-in and user-defined math and financial functions
- ☑ Ability to generate reports complete with plots and lists
- ☑ Polynomial finder
- ☑ Inequality solutions

Some of Eureka's key features

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- ☑ Constraints (like X has to be < or = 2)
- ☑ A function to plot
- ☑ Unit conversions
- ☑ Maximization and minimization problems
- ☑ Interest Rate/Present Value calculations
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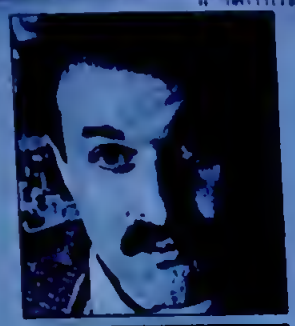

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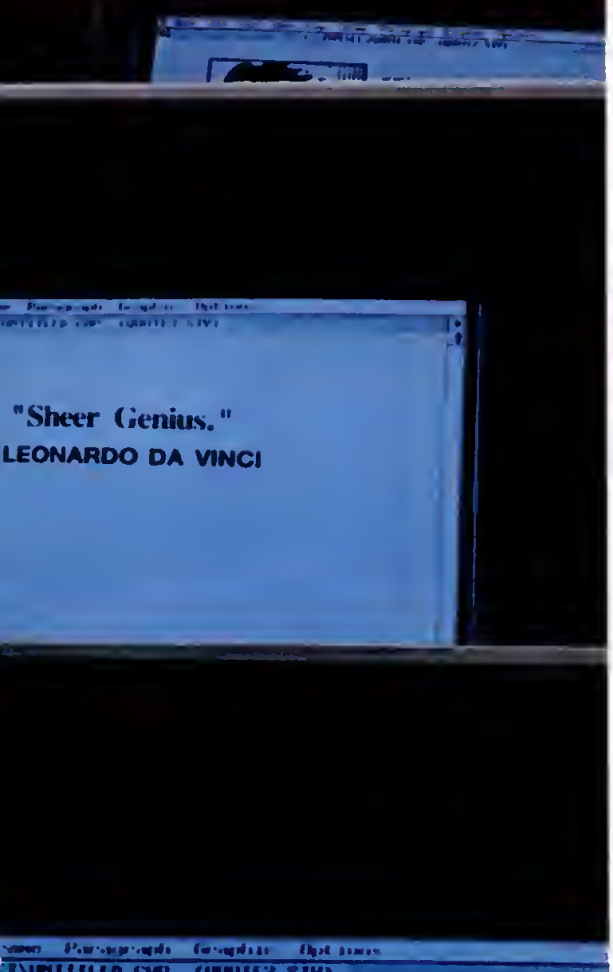

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Xerox Ventura Publisher, the easily mastered, industrial-strength publishing genius that runs on a standard IBM XT or AT, or compatible, just got better. Version 1.1 offers 80 significant enhancements for short document handling; text, graphics and font support; and broader output capability.

Xerox Ventura Publisher already gets raves for long documents; now Version 1.1 offers 20 additional features for producing short documents. There's automatic kerning, support for multicolumn frames, improved hyphenation, cropping and sizing of art, on-screen rulers, and automatic letter spacing, to name a few.

For documents of any length, page layout and type control have been raised from excellent to sensational. Pictures are now anchored to text during batch pagination. Documents up to 128 chapters in length, each containing 150 to 300 pages of text, are easily handled. The result is a desktop publishing package that can be judged by printing industry graphic standards.

To the longest list of text and graphics input support in desktop publishing comes even greater capability. Version 1.1 adds word processing interfaces for XyWrite, Displaywrite III and IV and DCA files. There's graphic conversion for more than 500 graphics packages based on a dozen file formats, including Macintosh "PICT" and image files. Plus downloaded PostScript fonts, conversion of H-P Soft-fonts and support for Adobe screen fonts.

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Xerox Corporation, P.O. Box 24, Rochester, NY 14692.
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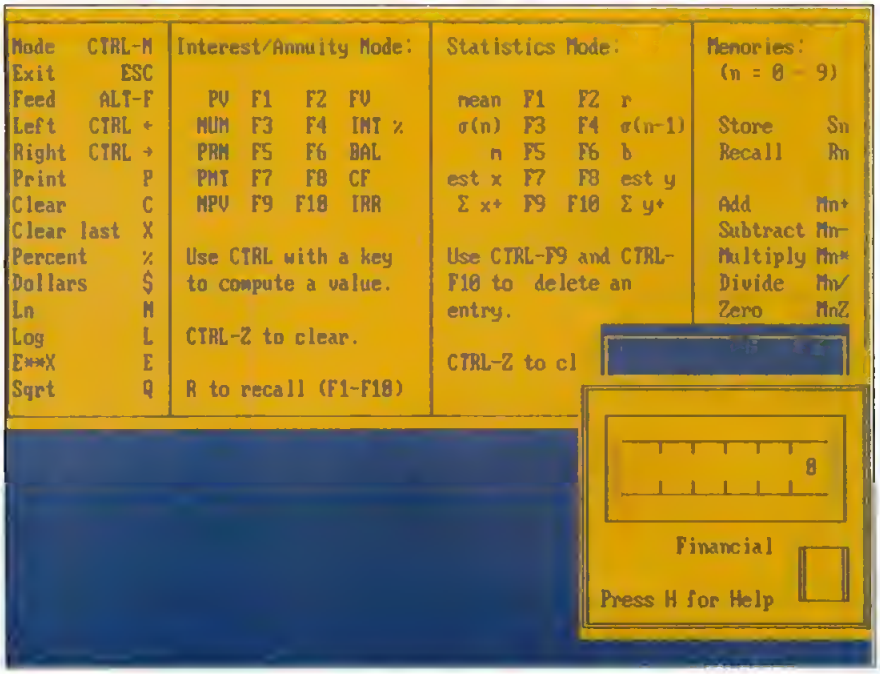

Partner-PC is distinguished by an impressive calculator. Among other operations, it can compute statistical functions, interest rates, and annuities. You can also use it to access a range of financial functions, including net present value, internal rate of return, and more.

and getting used to it takes too much effort.

You'll be pleased, though, with the way that the appointment scheduler and the address book are accessed through the memo pad. In this instance, the interface works well, because once you're used to the memo pad almost everything falls neatly into place for the other applications.

The notable exception is the phone dialer. While the dialer works well, an ill-advised attempt to integrate it with the address book limits it. I'd sacrifice the ability to dial a number from the address book for a well-implemented phone number list that I could quickly scroll through in the dialer itself. (No TSR desktop package has done this right yet. You'd think that with forms-based views of a simple relational file manager, separate phone and address views would be easy to manage.)

■ For 33K, *Partner-PC* gives you a full-featured financial calculator that alone is probably worth the price of the package.

Partner-PC has the other expected features, and they're well designed: typewriter mode for quick print jobs, control over typefaces, access to a few handy DOS commands, and a "Power Window" DOS subset, for which you can set the memory you want to use. These features all perform as you would hope, with ample help screens available from the standard F1 key. You can often move the window, change its color, and in the case of the memo pad, go to full-screen mode—a thoughtful enhancement. Better yet, you can toggle off the full screen temporarily to look at what's underneath.

Partner-PC has the best calculator of all the TSR desktop organizers I've seen. In fact, it has two: for 18K bytes you get a basic everyday calculator with percentage, dollar format, and ten memories, or for 33K you get a full-featured financial calculator that alone is probably worth the price of the package.

You can run the calculator in any of several modes: Normal, Statistics, Interests, and Annuity Begin and End. A full range of financial functions, using F1 to F10 as registers, includes present and future values, net present value, internal rate of return (IRR), and more. *Partner-PC* can handle continuous compounding, amortizations, or depreciation (straight-line, sum of the year's digits, or declining balance). In statistics mode, you have means, correlation coefficients, standard deviation, and so forth. You can perform two-variable analysis, forecast based on regressions, or switch back to normal mode for powers, logs, and trig functions.

All in all, the calculator is an outstanding utility, and all by itself makes *Partner-PC* worth serious consideration.

—Merv Adrian

PC-Desk

The concept behind *PC-Desk*, from Software Studios, is a good one: the $79 package is designed to run in partitioned memory, so it's always available when you press Alt-Esc. *PC-Desk*'s menu-driven utilities include a calculator, a word processor, a mailing list and telephone directory, a mail-merge utility, and a file encryption and decryption utility, as well as a time-keeping, expense, and telephone log.

You use a menu to load each *PC-Desk* application. Except for calling up the cal-

PC MAGAZINE FACT FILE

PC-Desk
Software Studios Inc.
8516 Sugarbush, #104
Annandale, VA 22003
(800) 272-3375
(703) 978-2339
List Price: $79
Requires: 192K RAM beyond other system requirements, one disk drive, DOS 2.0 or later.
In Short: A set of utility programs that can run alone or in 192K RAM of partitioned memory; includes menu-oriented access to features and prints Rolodex cards, compact phone directory, and other lists. Not copy protected

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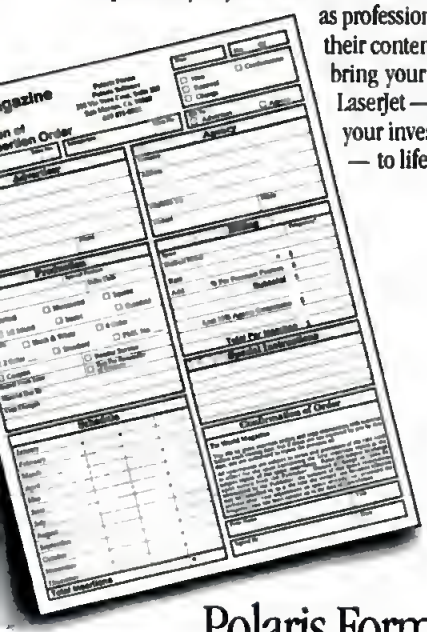

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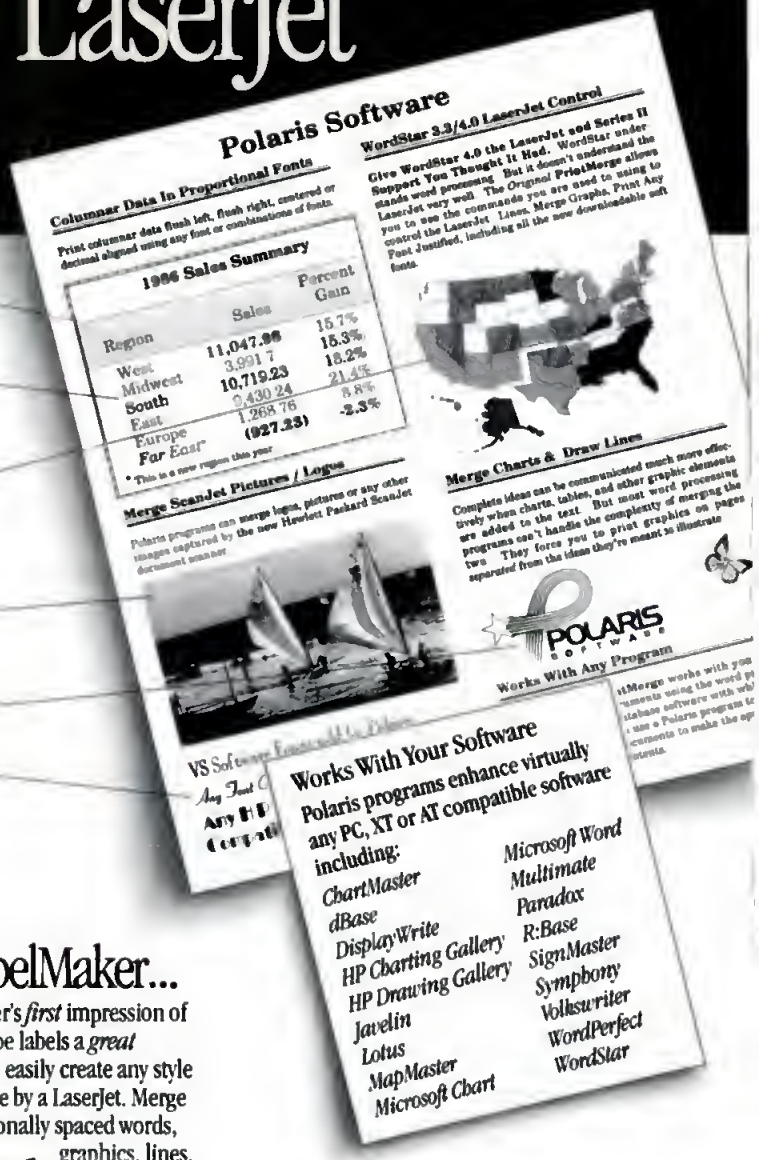

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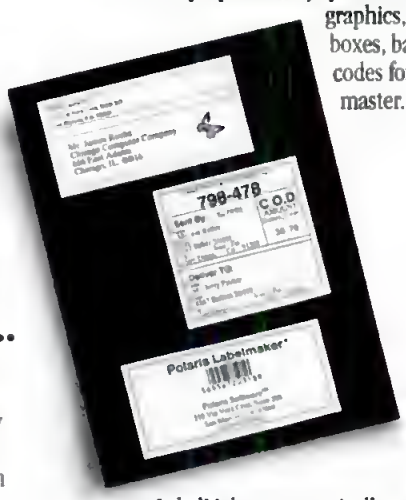

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613 West Valley Parkway, Suite #323
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CIRCLE 379 ON READER SERVICE CARD

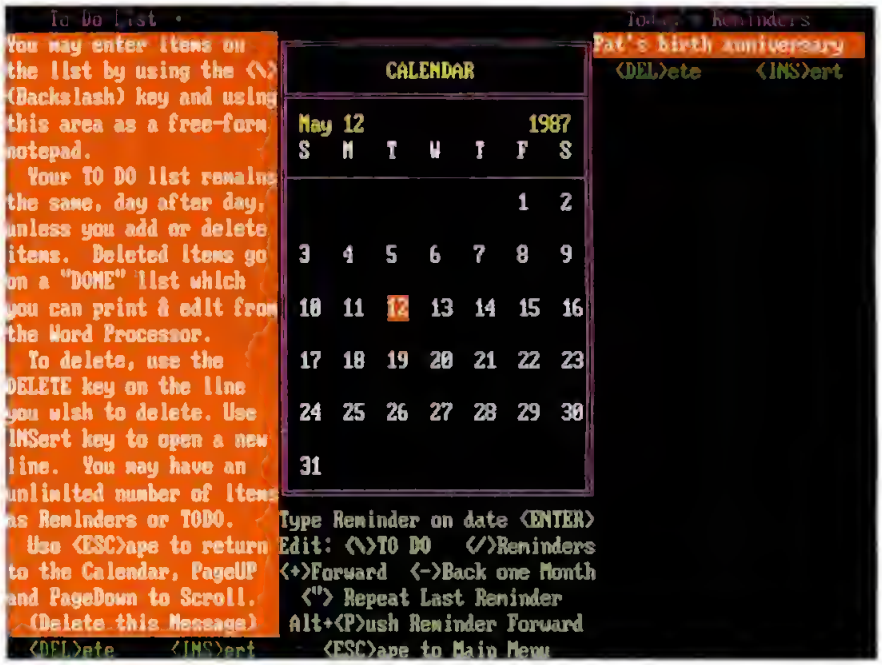
culator from inside the word processor, no two applications can coexist. Generally, when you exit an application and return to the main menu, you must explicitly save any data associated with the application; when you restart the application, you must request the information again.

PC-Desk includes a variety of print options. You can merge the address list, for example, with a form letter to produce mail-merge output, or you can print it on Rolodex cards, mailing labels, and envelopes. You can also print the address list as a telephone directory or in the form of a compact, pocket-sized "little black book."

PC-Desk's Timekeeper is useful for monitoring time and charges for clients or tracking time spent on a variety of projects. It displays a quarter-screen timekeeping chit that includes space for a client name, project type, description, time in, time out, and date. If the task is an expense-related item, the Timekeeper stores the dollar amount of the expense. The main *PC-Desk* access menu remains at the bottom of the screen during operation of the Timekeeper.

The auto-dialer is linked to the timekeeper utility to maintain a log of telephone calls made through the dialer. If you remember to log out of the project when the call is over, you have an almost automatic telephone log.

■ *PC-Desk*'s Timekeeper is useful for monitoring time and charges for clients or tracking time spent on a variety of projects.



Since PC-Desk *runs in partitioned memory, it is always available when you press Alt-Esc. You use a menu to load* PC-Desk *applications, which include a calculator, a word processor, a mailing list, and phone directory as well as the to-do list and calendar/reminder system shown here.*

PC-Desk's difficult-to-use memory-resident word processor displays text right-justified, so words are separated by variable-width spaces, which makes inserting new text a more elaborate procedure than it should be. A worse problem is that if you use long pathnames in file specifications, the on-screen file-save prompt is too long to fit on a single line. The result is a QuickBASIC error message. Even though the file appears to have been saved, no new data is added to the disk. In addition, just before a line wrap occurs, *PC-Desk* sometimes displays a BASIC error #5, and the cursor jumps to the head of the file. When I reported these flaws to Software Studios, the company said future editions of the software will eliminate them. (Registered users of *PC-Desk* can receive the latest copy of the software at any time by returning the program disk to Software Studios and requesting a new one.)

Also, *PC-Desk* does not erase user prompts for filename specifications during a save operation as new data is input from the keyboard. This quirk sometimes makes it difficult to determine what information the program is accepting as valid.

CALCULATING AND ENCRYPTING

PC-Desk's calculator is very basic, offering only add, subtract, multiply, and divide with a single memory register. It doesn't have a percent function, nor does it do any special financial or scientific operations. However, it's one of the easiest-to-use on-screen calculators you'll find.

The calculator window is more like a notepad window than a calculator. It is displayed as a thin reverse-video window with a block at the bottom to hold the total. You can enter data in arithmetic or Reverse Polish Notation (RPN), and the number displays at the left of the window with the operator to the right. The total is continuously updated, and the last 12 numbers are always visible in the calculator window.

The program's file encryption and decryption feature uses a combination of code characters to build an encrypted file that reads like garbage without the key used to scramble it. In fact, you can scramble the file more than once using successive keys to produce a file decipherable only through a combination of decryption steps, each with a different key.

PC-Desk has a lot of features, and they are generally pretty easy to use, but the package lacks polish and protection for your data. Unlike in most TSR utilities, current data in all *PC-Desk* applications (except the calculator) is lost when you exit and return to the main menu; you can't go back and forth from *PC-Desk* to your

standalone program and expect to have your data in *PC-Desk* waiting for you unless you've saved it to file. This practice is usual for standalone packages, but with a TSR utility, it's cumbersome and almost defeats the purpose. *PC-Desk* has a good concept behind it and may be a winner in later releases, but the version we reviewed has too many flaws.—**Tom Badgett**

PC-DeskTeam

PC-DeskTeam, from Alternative Decision Software, is a shareware product that offers the usual desktop utility functions, including alarm clock, calendar, calculator, DOS command interface, notepad, dialer, typewriter emulation, and printer control—all for a $25 registration fee. You can configure *PC-DeskTeam* to operate as a TSR program or as a standalone.

The program's main menu gives you access to all the features. Although some of them are not as sophisticated as those of competing products (the phone directory supports only about 20 characters for each number description, for example), users who need only the basics and for whom price is a consideration will find *PC-DeskTeam* an excellent choice.

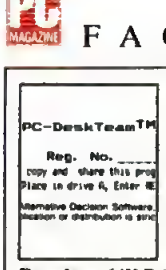
PC-DeskTeam has several strong features. You can capture any number displayed on the screen and insert it into the calculator, for example. The DOS command interface provides an abbreviated list of DOS commands from within any application. The program's ability to list a directory, rename a file, delete files, and check available memory can be particularly useful.

PC-DeskTeam's printer control feature allows you to preset a printer for compressed, emphasized, or other enhanced print outside of the application you are using to print information. The typewriter emulator solves another nagging problem of computer users who want to address a simple envelope or type a single label. With *PC-DeskTeam*'s typewriter, what you type on the keyboard appears on the printer.

PC-DeskTeam requires only about 64K bytes of RAM, and the various features pop up quickly. Overall the package is fast, and it permits you to configure such features as display colors and printer commands and features.

A shareware product from Alternative Decision Software, PC-DeskTeam *includes the most-common desktop utility functions—all for a $25 registration fee. Shown here is the phone directory, which supports about 20 characters for each number description.*

PC MAGAZINE FACT FILE



PC-DeskTeam
Alternative Decision Software Inc.
P.O. Box 307
Lancaster, NY 14086
(716) 688-6673
List Price: $25 registration fee

Requires: 64K RAM beyond other system requirements, one disk drive, DOS 2.0 or later. Printer and Hayes or Hayes-compatible modem optional, but recommended.

In Short: Shareware TSR or standalone utility that includes everything a new user, and many experienced ones, require, with menu access and on-line help; the vendor encourages distribution of the software. Not copy protected.

CIRCLE 668 ON READER SERVICE CARD

The on-disk manual is complete and well-written, and adequate on-line help supports the easy-to-use program. You can move the windows around the screen and select foreground and background colors from an interactive menu.

This package's shortcomings are few. It lacks some of the enhanced features of a package like Lotus's *Metro* and doesn't support general screen-capture features; plus you can't stack up applications, as you can with *SideKick*. The phone directory does not support a full name and address file, and you can't dial an on-screen number outside of the phone dialer. In addition, the only way to remove the utility from RAM-resident mode is to reboot the system.

While *PC-DeskTeam* isn't as versatile as some of its commercial competitors, it is quick as well as easy to install and use, it supports a variety of printers and displays, and the price is right. Since it has the support of The PC-SIG Library for distribution, *PC-DeskTeam* will likely find many users who can easily justify the $25 registration fee for the TSR desktop utilities most users want. At the very least, it's a good choice for beginning TSR software users to help assess what features are important and to learn how these packages function. And some users may find that *PC-DeskTeam* gives them all they need.
—**Tom Badgett**

Perks-PC

Barry Watzman's *Perks-PC* is a PC-compatible version of *Perks*, which for some time has been a popular product for the Zenith Z-100. In fact, when the Navy made their legendary purchase of the Zenith laptops, the $69.95 *Perks* was part of the deal.

It's easy to see why: *Perks-PC*, also $69.95, offers a lot of no-nonsense features: notepad, appointment and perpetual calendar, calculator, card filer, communications capability, dialer, alarms, and DOS utilities. The documentation is crisp, relatively technical (although packed with intelligent explanations), and complete.

CUSTOM FIT *Perks-PC* shows its laptop background here and there: it doesn't use the PgUp and PgDn keys much, it uses little memory (72K bytes), and it handles video well. You invoke *Perks-PC* with the double Shift key combination, but as with many other *Perks-PC* features, you can reconfigure the keys by using the package's extensive options.

Being able to configure *Perks-PC* the way you want is one of its strongest features. Although it's easy to remember the Alt-key mnemonics you use to invoke various functions, you can change them, size the windows, remove *Perks-PC* from memory, and save the configuration you like after tinkering. Moving windows is easy as well; you simply use Ctrl-cursor keys.

FEATURES The notepad uses *WordStar* commands, although it imports and exports nondocument mode text easily. It doesn't support word wrap or print formatting, however.

Perks-PC includes a typewriter utility that echoes keystrokes to the printer. It offers three settings: two immediate modes (one for dot matrix printers that require a terminator before printing) and one buffered mode.

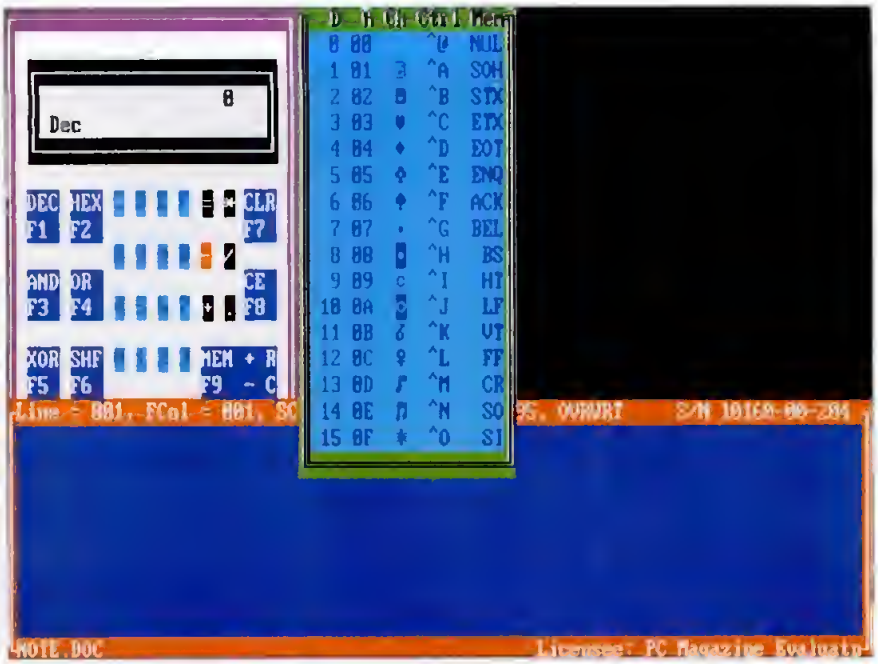
The four-function calculator has an added attraction: a hex mode with programmer's logic functions (AND, OR, XOR, and SHIFT). The calculator does not have a "tape" display, but you can export the results.

To get to the program's appointment calendar, you go through the perpetual calendar, which will give you any date you want in the 20th century and comes up with the system date as a default. *WordStar* (and *Perks-PC* notepad) cursor control commands like Ctrl-E and Ctrl-X move you around the calendar, similar to the way they move you around a word processing document. The documentation carefully explains how to set up appointments, including how much memory you use in storage and how to accommodate it.

The card file is a relational table that assumes two keys, last name and ZIP code, for simplicity. A suggested format is included, corresponding to a typical name-and-address Rolodex card. With this format, you can use the program's label printing, sorting, and auto-dial (with Hayes-compatible modem) capabilities. But you can also lay out fields and assign the keys any way you wish. *Perks-PC* enables you to do various data scans, including key-sequenced (by either key), physical sequence from beginning or end, and a string search mode. Once again, the commands are consistent.

Perks-PC's communications capabilities are not limited to dialing card file entries. A rudimentary file transfer capability supporting Xmodem is also included, and it's a real plus over most of the competition. You can also invoke the dialer separately. If you have the card file or notepad on your screen, the dialer will find a number if one is there and dial it after you confirm by pressing Enter.

The configuration utilities are on the same submenu as the DOS utilities, which exclude CHKDSK, MKDIR, and FOR-



One attractive feature included in the Perks-PC *four-function calculator is a hex mode containing programmer's logic functions such as AND, OR, XOR, and SHIFT. The package also includes an ASCII table and a notepad that easily exports and imports text.*

FACT FILE

Perks-PC
Barry Watzman Micro Computer Systems and Consulting
560 Sunset Rd.
Benton Harbor, MI 49022
List Price: $69.95

Requires: 72K RAM beyond other system requirements, one disk drive, DOS 1.0 or later.

In Short: TSR utility with a lot of no-nonsense features; one more round of improvements would make it a real winner. Not copy protected.

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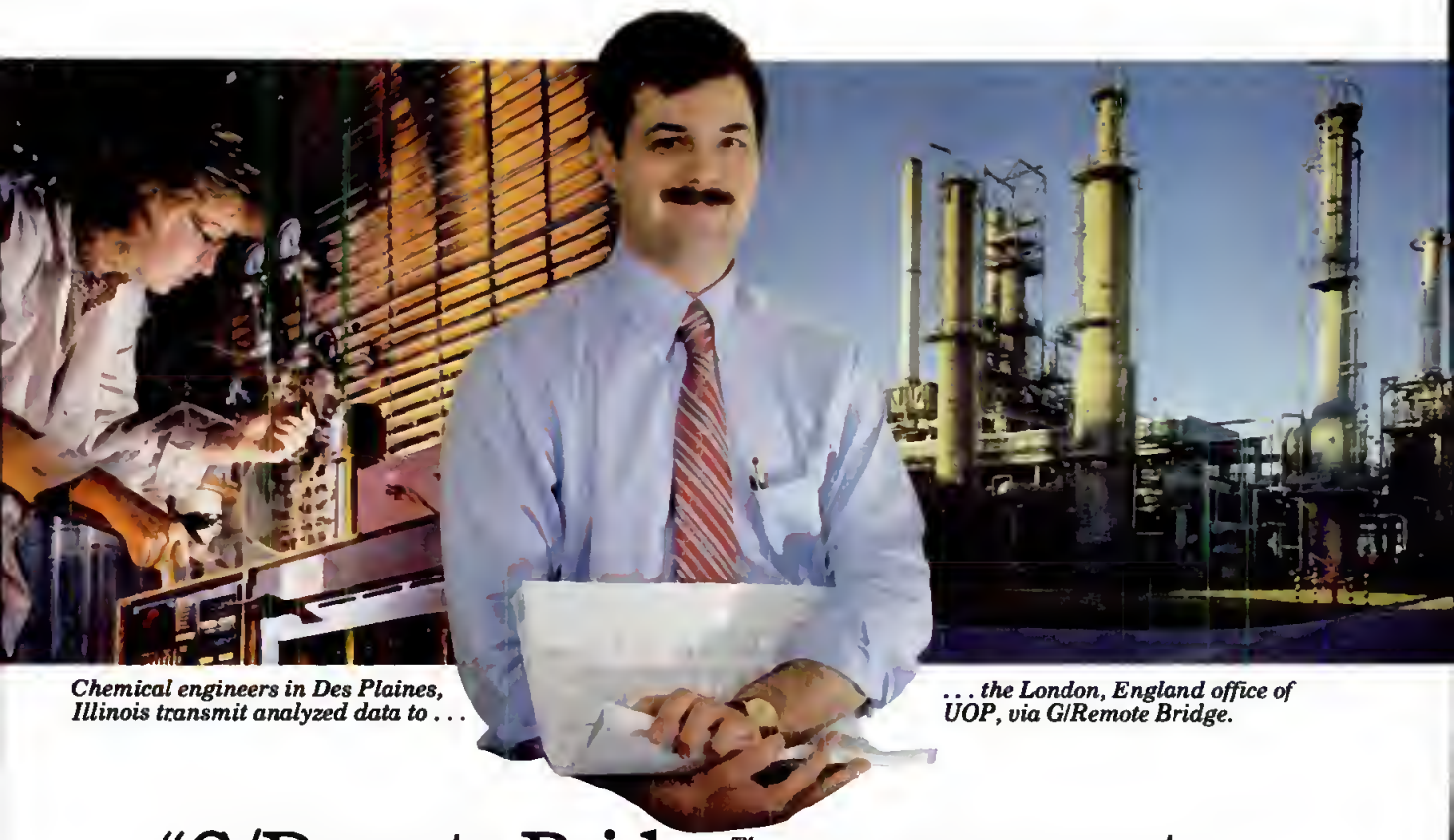

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MAT. You can set colors for the various utilities, save the configuration, and point to the subdirectories to be used by help files, by the appointment calendar files, by the card files, and by *Perks-PC* itself. The eight alarm timers, also on the submenu with the configuration and DOS utilities, accept entries in 24-hour format, but you cannot associate a message with the alarm.

Perks-PC is a well-done product. One more round of improvements would put it at the top of its class.—**Merv Adrian**

PolyWindows DeskPlus

PolyWindows DeskPlus, an $84.95 program from PolyTron Corp., already has quite an installed base: over 100,000 units. In fact, the first release, called simply *PolyWindows*, was also part of the package Zenith sold along with its laptop to the Navy. *PolyWindows DeskPlus* is the second release. The company announced the third release, *Desk III*, in April, but as of press time we had not received it.

PolyWindows DeskPlus is a polished package with the consistency and comfort of a one-programmer creation. The program's menu style is an attractive pull-down interface with five categories: Documents, Card Files, Desk Tools, Add-on Tools, and DOS. A batch file installs the program on a hard disk, and a startup file called BEGINNER loads a complete (100K) configuration for the new user (you can remove the tools you don't want later). Ctrl-Esc gives you a menu at the top of the screen, and you're on your way.

Using the secondary menu for Documents, the relatively full-featured editor, you get printing, formatting, searching, and a number of other commands. The edit options include find, change, margins, word wrap, and block manipulation.

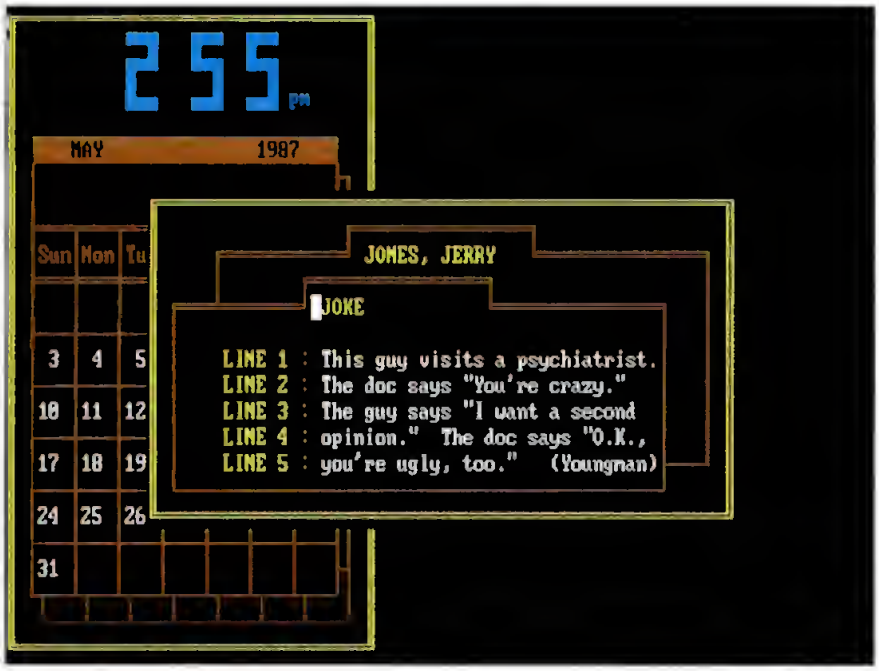
If you wish to use a particular file other than the default MEMO available directly to the editor, the INCLUDE command from the POLY directory will put the file on the menu when you call up the editor—a nice touch. POLY also allows you to load files with the menu selection Load/Save.

Getting into Help (with F1) shows you how the card system works; the program developer used it for the Help function. The program also has a DEMOFILE, used with the card function, which includes some help on its use. PolyTron says the data files in *Desk III* are *dBASE III* compatible. In fact, you will be able, it says, to create *dBASE III* files directly with *Desk III*, import *dBASE III* files into *Desk III*, and export existing *PolyWindows DeskPlus* files as well.

The PolyKey functions are the macro recorder and library. You can apply these sets of macros selectively. You may have a set of macros for an application that is not active within *PolyWindows* itself. Up to ten different macro files can be in use in any session (INCLUDE at the DOS prompt is the command to load a file into the macro processor), and each file may include up to 60 key redefinitions. A screen saver on the submenu blanks the screen after a certain period of inactivity; few other desktop organizers offer this handy utility.

PolyWindows DeskPlus's Calendar has separate Note and Datebook functions. The Notes are short, entered with the Ins key on the date concerned. They appear at the top of the Calendar when you're on the date they apply to. You access the Datebook from the submenu, along with the hourly chimes and the alarm function.

The auto-dialer is typical, with the handy addition of being available outside the regular menu structure; hitting Ctrl-Spacebar accesses it instantly. You may dial at 300- or 1,200-bits per second on any of the COM ports, from the keyboard or by



PolyWindows DeskPlus *comes with a calendar that has separate Note and Datebook functions. A particularly nice feature of the calendar is that it allows you to create notes that will appear on top of the calendar when you reach the date the notes apply to.*

PC MAGAZINE FACT FILE

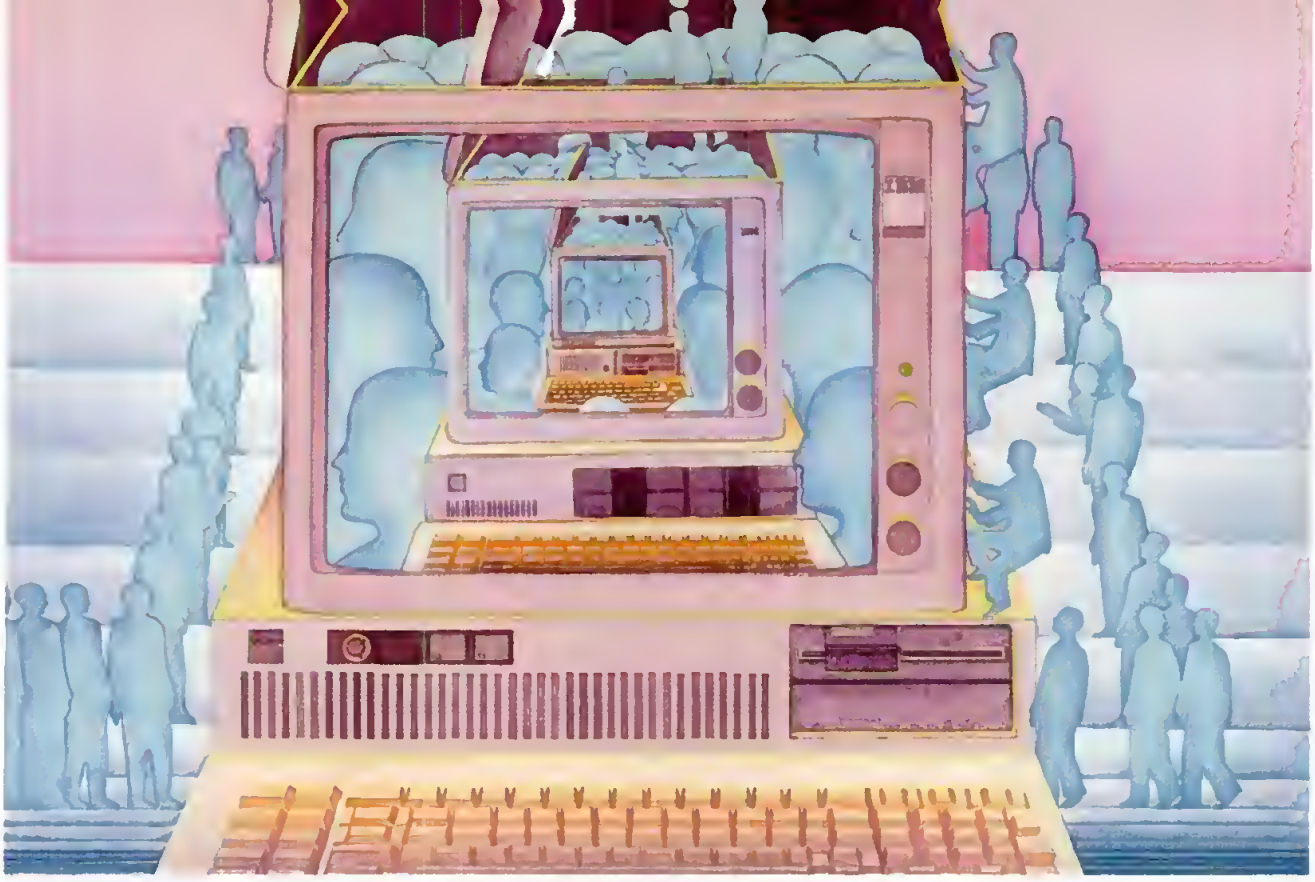
PolyWindows DeskPlus
PolyTron Corp.
1815 NW 169th Pl.
#2110
Beaverton, OR 97006
(800) 547-4000
(800) 684-3000 (in Oreg.)

List Price: $84.95

Requires: 80K RAM beyond other system requirements, one disk drive, DOS 2.0 or later, Hayes or Hayes-compatible modem for auto-dial feature.

In Short: A polished, consistent package with an attractive pull-down menu interface, offering five tools: Documents, Card Files, Desk Tools, Add-on Tools, and DOS. Not copy protected.

CIRCLE 666 ON READER SERVICE CARD



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picking a number off the screen, and you can select both tone and pulse. Unfortunately, *PolyWindows DeskPlus* has no specific phone book application.

The calculator ranks a bit above ordinary, with a fairly standard set of features: four functions, memory, choice of decimal places, automatic switching to exponential notation if appropriate, comma toggle on/off, and tape display/print toggles. The programmer's calculator, which you must load separately, handles computations in decimal, binary, octal, or hex. *PolyWindows DeskPlus* also supplies an ASCII table as well as a little puzzle game.

The program offers the usual DOS functions, including CD, MD, CHKDSK, DEL, DIR, an extended version of TYPE, and REN. Hercules support extends compatibility, with two different Hercules modes available.

PolyWindows DeskPlus also offers the Grabber, its version of a clipboard. You can highlight and export a section of your screen to another application. You can change the color, location, and shape of windows by using simple commands at load time. In addition, you can use the REMOVE command to get rid of options you no longer need (like a particular set of macros) to free up some memory.

■ The *PolyWindows Desk-Plus* calculator computes in decimal, binary, octal, or hex.

As Lotus does with *Metro*, PolyTron markets a number of other tools for the *PolyWindows DeskPlus* environment: an archiving program, an encryption tool (DES or PolyTron's own algorithm), and a memory-resident communications utility. The new release is packed with additional features, but our hands-on analysis is required before we pass judgment. If *PolyWindows DeskPlus* is any indication, though, *Desk III* looks like it'll be a smooth and easy performer.

—**Merv Adrian**

Pop-Up DeskSet Plus

Popular Programs' *Pop-Up DeskSet Plus* is a $129.95 desktop utility for the user who wants it all and who has the skill to have it his way. This extremely flexible set of TSR utilities has all the features of standard desktop organizers and more, and you can configure it from the DOS prompt or by using menus inside the applications.

The package's programs include two calculators, Pop Word (the text editor, notepad, scheduler, and address book), Pop Voice (the dialer), Pop Modem (the on-line communications), the alarm clock, the DOS interface, and Pop Anything (a program that allows you to exit a running application and run something else). Two versions of the package are sold, *DeskSet* and *DeskSet Plus*; the latter adds communications and terminal emulation software to the basic package.

Each program loads separately, but you can write a batch file to install as many or as few of the applications as you need. The Autopop install program helps you select the correct combination of applications and writes an AUTOEXEC.BAT file or modifies an existing one. A DOS-level switch or flag to set parameters can load all the pop-up applications.

Although the *Pop-Up DeskSet* user's manual cautions that some programs may be incompatible with Pop Anything, no major compatibility problems cropped up during our tests. We used *Pop-Up DeskSet* with *1-2-3*, Release 1A and 2, *dBASE III*, *WordPerfect*, IBM BASICA, and a handful of other applications and utilities. We encountered no problems.

Pop-Up DeskSet Plus has two communications programs. One is designed to dial the phone for voice communications, using an electronic phone directory. The other, Pop Modem, provides full terminal emulation in addition to the dialing function, so that you have quick access to online communications like electronic mail without having to exit your current application.

Unfortunately, the Pop Modem program is not that easy to use. Even though on-screen prompts clearly show the function of various keys, the program's interface is not as intuitive as it could be. Pop Modem includes VT-100 emulation, but it wasn't totally compatible with the expectations of a DEC MicroVAX II running

The Pop Voice communications program included with Pop-Up DeskSet Plus *dials the phone for voice communications, using an electronic phone directory. The Pop Modem program provides full terminal emulation in addition to the dialing function.*

PC MAGAZINE FACT FILE

Pop-Up DeskSet Plus
Popular Programs Inc.
135 Lake St., #210
Kirkland, WA 98033
(800) 447-6787
(206) 822-7065 (in Wash.)
List Price: $129.95. DeskSet, $69.95, *TSR-MAN*, $39.95.
Requires: 64K RAM beyond other system requirements, one disk drive, DOS 2.0 or later, 128K RAM and a modem required for *Pop-Up* voice application.
In Short: Extremely flexible and fast TSR utility offering many helpful features, including the optional *TSR-MAN*, to help you manage your TSR software. Not copy protected.
CIRCLE 665 ON READER SERVICE CARD

VMS in the tests we conducted. It's handy to be able to use it to check an MCI or CompuServe mailbox, though, without exiting a running application.

Pop-Up DeskSet has two calculators also. One is a fairly simple, four-function calculator with ten memories and a percent key. The second is a sophisticated financial and statistical unit. The simple calculator requires only about 16K bytes of RAM; the financial model uses 31K. If you don't require the sophisticated financial functions, you can load the simpler version of the calculator, leaving more memory for other *Pop-Up DeskSet* applications or other programs.

Both calculators display a continuous tape to show keystroke entries and results. By hitting the P key, you can print the tape as you enter data, but you can't print a tape for data that you've previously entered. A single keystroke feeds the value currently displayed on either calculator window to a running application or to DOS. Data fed to an application appears where the cursor was last positioned.

The financial calculator has a single-screen help display that pops up behind the calculator and stays there as you calculate. Although you can freely move the calculator around the screen, it remains relatively small compared with calculators found in other TSR programs. The reverse video-tape shows the keystrokes as you enter them.

POP WORD You can use Pop Word, which supports the major word processing functions, in a small, vertical window or in a full-screen display. All Pop Word functions are reasonably easy to use; if you're a current or former *WordStar* user, they'll come to you naturally since Pop Word supports several *WordStar* commands. Other cursor control keys are fairly standard and easy to learn.

Pop Word also includes a scheduler and an address book. You can maintain phone number lists, which the dialer, Pop Voice, can dial. As with other *Pop-Up DeskSet* applications, the scheduler and the address book offer on-screen prompts and are easy to use. They actually function as special-format word processing files, but they are not compatible with other applications.

Pop Word, which is relatively fast, uses an interesting approach to the problem of limited RAM storage for a document. The default reserved for a Pop Word document is 4K bytes. With most programs of this type, when you run out of RAM, the document fills up; to save it, you have to start over. *Pop-Up DeskSet* simply asks you to press Shift-PgDn to enter the next section, which it stores and retrieves from disk. This method may seem a little slow, especially after you've become accustomed to the fast action of TSR editing, but it works. Plus it lets you keep a reasonably small portion of RAM ready for word processing while supporting larger documents.

Pop-Up DeskSet Plus's calendar shows a small, one-third-screen display of the current month, which appears blinking, and the previous and next months. You can expand the calendar to show a single month on a full screen, with major holidays and events indicated. You can add to or modify the messages from a menu-prompted screen, storing up to 15 messages for any single date, with 2 displayed at a time. In addition, you can print the calendar displays for reference.

AVOIDING CONFLICT The package uses a slick technique to avoid conflict with other software. If another of your applications programs uses one of *Pop-Up DeskSet*'s Alt-key combinations, you need only press the Alt-key combination twice. The first time you will see the associated *Pop-Up DeskSet* application, but the second time the *Pop-Up DeskSet* program disappears and the key combination is passed through to your application. Once you get used to this procedure, it's easy and works well. In addition, you can specify a different key combination to initiate the *Pop-Up DeskSet* software by using one of the DOS-level switches to load it.

The DOS limit for pathnames is 64 characters, but *Pop-Up DeskSet* recognizes pathnames only up to 31 characters—limiting for hard disk and network users. You access *DeskSet* data in deep directories by making the desired directory the DOS default and calling up the *DeskSet* application. If you do not specify a pathname, *Pop-Up DeskSet* assumes you want a file in the current directory.

Along the right side or the bottom of most displays is a short prompting menu that shows the operation of the function keys. One irritation with this set of utilities is that there is no way to dump them from memory once they have been loaded. Popular Programs solves this problem with a separate software package called *TSR-MAN* (originally called *Pop Drop*). By loading each TSR utility—from Popular Programs or other vendors—with *TSR-MAN* instead of directly from DOS, you can display a list of active TSR software and drop them from memory one at a time or collectively as required. With *TSR-MAN*, each TSR application requires an additional 1.5K bytes of memory.

Users who demand flexibility and speed and want all their organizers in one package will find that Popular's *Pop-Up DeskSet Plus* will grow more popular with them with every use.—**Tom Badgett**

■ *Pop-Up DeskSet Plus*'s Pop Modem gives you quick access to on-line communications without your having to exit your current application.

How rewrote a

First we wrote a wish list. With help from the 500,000+ people who've already chosen MultiMate® for word processing.

We also had help from a whole new generation of users. Professionals and managers who want quick results from the software they use.

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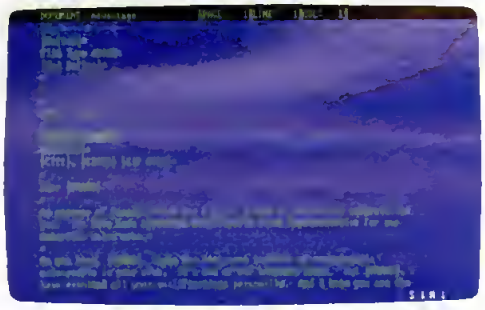
The result is MultiMate Advantage II.™



A few simple commands let you directly merge dBASE files without leaving MultiMate. And without knowing how to work dBASE. Which makes it easy to create stacks of personalized form letters.

Within seconds of booting up, its Hot Start feature lets you create and edit simple memos without fussing with menus. There's also a Hot Print feature that prints out memos at the touch of a key.

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Fred's Encyclopedia Inc.

June 8, 1987

Mr. Steve Davison
315 El Divisadero
Walnut Creek, CA 94596

Dear Steve,

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John Martini

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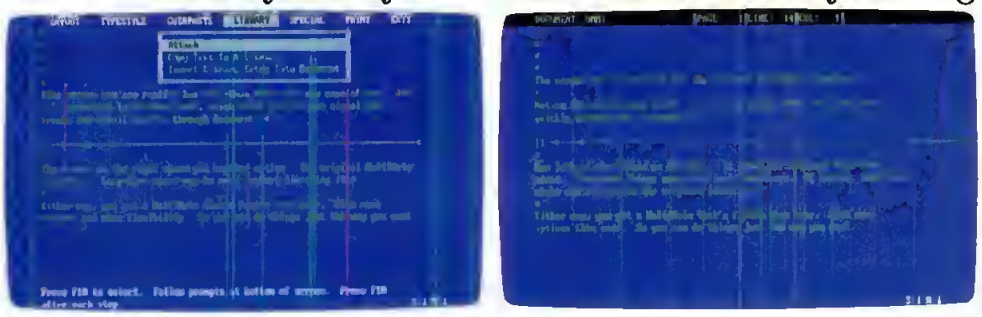

Now you can access the power of MultiMate with simple pull-down menus (left) or choose the original interface (right). Both interfaces have document mode for visible page breaks and fast scrolling.

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CIRCLE 208 ON READER SERVICE CARD

Power-Up! One-Key Combo

The *Power-Up! One-Key Combo*, sold by Channelmark Corp. as a package for $49.95 and individually for $24.95, includes separate interrelated products that correspond to the commonly used TSR desktop organizer functions: One-Key Memo Pad, One-Key Calculator, One-Key DOS, and One-Key Timekeeper.

The attractive, reasonably functional One-Key Memo Pad uses about 29K bytes of memory, giving you 18 lines of 50 characters each on the screen. Each note can be up to 4,000 characters. The Memo Pad's useful "Exit and feed buffer" option permits you to dump a note file into some other package as if you had typed it in at the keyboard.

The Memo Pad saves its files, as most TSR products do, as ASCII files and includes word wrap and print among its functions, but it uses an odd line length, confusing some conversion routines that come with commercial word processing packages. You can leave the notepad and return to your application, and when you invoke the notepad again, you'll be pleasantly surprised to see the same document there—a very handy feature.

You may encounter some problems when you use the Memo Pad at the same time as the One-Key Calculator. The problem is really very simple: if you bring up the Calculator over the Memo Pad, once you exit, you're locked up, and even a warm boot won't work. If you want to use the Memo Pad to its full advantage—for example, by relying on a document staying in memory—you've got a real problem. Other minor annoyances: you cannot save and exit in one operation, you cannot move or size the Memo Pad, and you cannot set the colors.

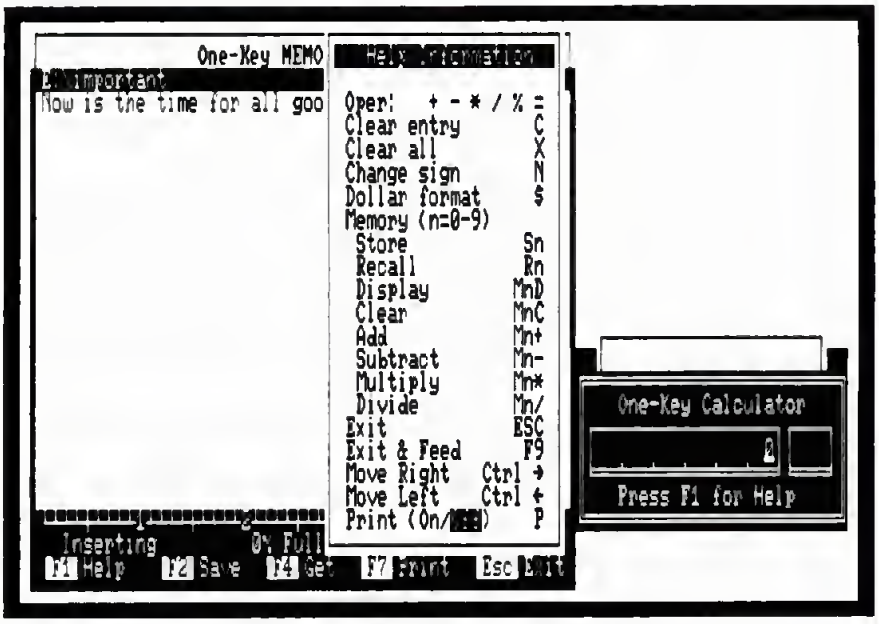
The One-Key Calculator, which uses 16K, has the usual "paper tape" output display and supports simple math. Nine memories are available, and a "Dollar format" is an option. You can print output from the calculator as well as view it on the screen.

The Calculator is another incompatibility culprit. You can seemingly call it up and leave it from the other One-Key applications (except the Memo Pad), but if you start another application from within the calculator, you often run into problems.

One-Key DOS is a quick route to a second session of DOS, demanding 44K. Using Alt-F3 within another program (but not within the Memo Pad, interestingly enough), you can call on DOS to do certain things. As with most of the DOS subset packages, though, you can't use it to perform a number of DOS commands, including PRINT, BASIC and BASICA, and PROMPT.

The One-Key Timekeeper, a 27K program, sets up to nine daily alarms, has monthly calendars from 1928 to 2027, permits you to time six events simultaneously, and displays the current time while other software runs.

The bottom line on the copy-protected *Power-Up! One-Key Combo* is that the One-Key programs are worth more separately than they are together. They have compatibility problems even with each other, and used together (if you're lucky enough to avoid a crash), they take up far too much memory for the utility they provide. The *One-Key Combo*'s unintegrated approach, without a central menu, doesn't supply the capabilities you want in a TSR desktop organizer.—**Merv Adrian**



Though the separate programs of the Power-Up! One-Key Combo *work well on their own, they suffer from compatibility problems when used together. For instance, if you bring up the Calculator over the Memo Pad, your PC is likely to lock up when you try to exit.*

PC MAGAZINE FACT FILE

Power-Up! One-Key Combo
Channelmark Corp.
2929 Campus Dr., #400
San Mateo, CA 94403
(800) 851-2917
(800) 223-1479 (inside Calif.)

List Price: $49.95; $24.95 for any single one in the series.

Requires: 16K RAM (One-Key Calculator) beyond other system requirements, 29K RAM (One-Key Memo Pad) beyond other system requirements, 27K RAM (One-Key Timekeeper) beyond other system requirements, 44K RAM (One-Key DOS) beyond other system requirements; one disk drive, DOS 2.0 or later.

In Short: A series of programs that are separate but interrelated, corresponding to the commonly used TSR desktop organizer functions: One-Key Memo Pad, One-Key Calculator, One-Key DOS, and One-Key Timekeeper; its unintegrated approach, without a central menu, lacks flexibility and limits ease of access. Copy protected.

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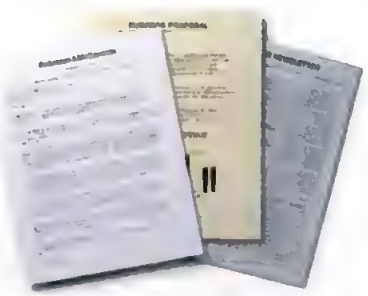

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Torrance, CA. 90508 • (213) 327-2110

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SideKick

With about 750,000 copies sold, Borland's *SideKick*, one of the original TSR utility packages, has become the standard against which competitors are measured. Unlike Lotus's *Metro*, *SideKick* keeps all utilities in RAM for instant recall, so *SideKick* comes when you call it a lot faster than *Metro* does. And because *SideKick* keeps everything in RAM at all times, you don't use any more memory as you call up subsequent applications.

Once you've installed the $84.95 *SideKick* and are running your word processing or spreadsheet application, for example, you call the desktop utility by pressing Ctrl-Alt. *SideKick*'s master menu appears instantly to access any of the program's organizers. Using one key (a function key or a single-letter abbreviation) or an Alt-key combination, you can select Help, NotePad, Dialer, Calculator, ASCII-table, Setup, and Exit. A bottom-line screen menu displays function key assignments, with on-line help available.

SideKick lets you stack up all the utilities, one at a time, and move forward and backward through them with the Esc key and an appropriate Alt-key combination. You can even return to a previously displayed application directly without exiting subsequent programs. You can also elect to install only selected utilities, freeing additional RAM.

WordStar users will be immediately comfortable with the *SideKick* NotePad because it mirrors *WordStar* commands. A separate install program lets you assign an additional set of keystrokes for these functions so that *SideKick*'s NotePad can support *WordStar* commands as well as those of another word processor. The NotePad supports standard word processing features, including block operations.

The screen-capture facility is extremely useful. Once you enter the NotePad, you can press F4 for *SideKick* to remove it and place the cursor at the top left corner of the screen. You can then use the cursor keys to position the cursor at the beginning of a screen block that you want to copy, then issue *WordStar*'s command to mark the beginning of a block (Ctrl-KB). A reverse video block cursor then lets you paint the area of the screen to capture to the *SideKick* NotePad. You can save the screen image as a text file and incorporate it into any other word processing document.

The Dialer uses the NotePad to create a fairly free-form directory list, but you can auto-dial any telephone number displayed on the screen. After searching a *dBASE* database or text file for the number you want to dial, you can call up the dialer to complete the call from the number displayed on the screen.

SideKick's Calculator also supports number conversion. You can enter a number in decimal format and, by pressing the H key, display the hexadecimal equivalent. The B key brings up the binary version of the number. By overlaying the NotePad on top of the Calculator, you can capture key numbers for inclusion on text documents or for printing.

COMPATIBILITY *SideKick* is a popular package that has been around long enough to undergo several refinements. Early compatibility problems, have mostly been solved, and complaints of *SideKick* locking up with this application or the other are getting fewer. The latest release has answered a number of user complaints and suggestions, including an attempt to standardize function key assignments among various applications. The latest version also occupies about 14K bytes more RAM than earlier releases.

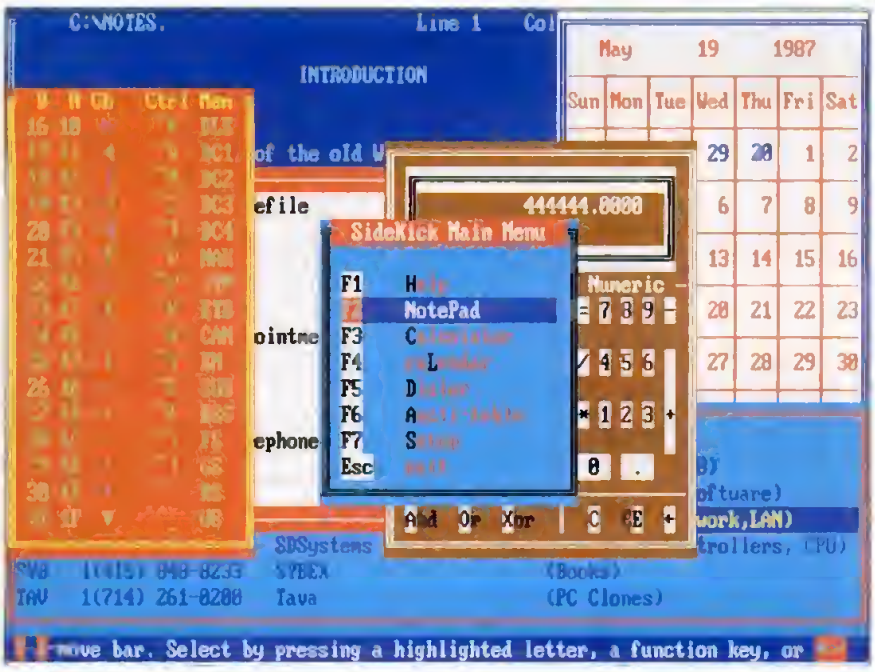
Overall, *SideKick* is easy and natural in operation. Its combination of features is

FACT FILE

***SideKick*, Version 1.56B**
Borland International
4585 Scotts Valley Dr.
Scotts Valley, CA 95066
(800) 255-8008
(408) 438-8400
List Price: $84.95

Requires: 128K RAM beyond other system requirements, one disk drive, DOS 2.0 or later, Hayes or Hayes-compatible, PC*jr* Internal, or AT&T Modem 4000 or VOAD keyboard phone required for auto-dial feature.
In Short: The best-known, original TSR utility, quick on its feet and capable, with good on-line help; can be removed from memory without rebooting. Not copy protected.

CIRCLE 663 ON READER SERVICE CARD



SideKick lets you stack all of its utilities, one on top of the next. You can move forward and backward through them with the Esc key and an appropriate Alt-key combination. You can also return to a previously displayed SideKick *application without exiting subsequent programs.*

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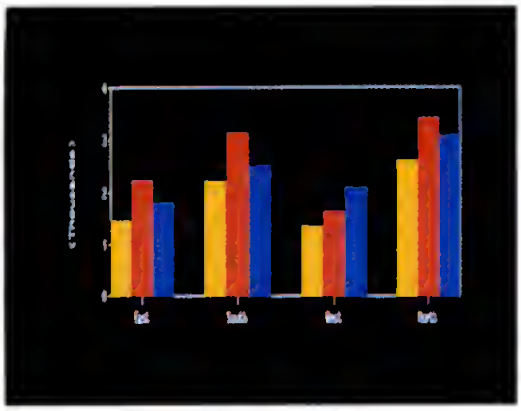
To get Lotus 1-2-3 to do all this more quickly and easily, we didn't make it more powerful.



Lotus HAL doesn't change 1-2-3 or the worksheet. It makes things easier. For instance, to graph sales by district from January to March just request ***"graph Jan to Mar."***

You can spend a lot of time setting up your spreadsheet. Summing up sales figures is a good example. With Lotus HAL, just request ***"total all rows"*** *and 1-2-3 and Lotus HAL will create the formulas.*

Say you want to extract just the information you want from a database. For example, you want to determine your top sales reps. Simply request ***"who has sales ≥ 8000."***

You may find yourself in the position of figuring out how a spreadsheet was built. Well, with Lotus HAL, you simply request ***"list the relations in the sheet."*** *And away you go.*

Do you find it hard to sort things by district or sales or any other criteria? Just request ***"sort by dist."***

To ***create macros,*** *well, you may not believe this. What you see here isn't a description of what's happening—it's the actual macro. See, we told you you wouldn't believe this.*

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How? With Lotus HAL™—a Companion product for 1-2-3® that helps you take shortcuts, undo mistakes, link spreadsheets, use your own words for commands and basically get more out of 1-2-3 than ever.

So much more, that Computerworld has named Lotus HAL "Product of the Year."

The screens on the left will give you an idea of how easy it is to get more out of 1-2-3. And these are only a few of the enhancements and new features Lotus HAL brings to 1-2-3.

Lotus HAL gives you the ability to perform 1-2-3 tasks using simple English phrases—called, logically enough, "requests." This has advantages for all kinds of 1-2-3 users: the newer users will find that difficult tasks are now simplified; the more experienced users will find that many time-consuming tasks can now be performed in a fraction of the time.

In addition to this powerful capability, Lotus HAL also allows you to test assumptions, correct mistakes and simply change your mind with ease. Because through a special capability called "undo," Lotus HAL lets you reverse your last command—even retrieving a file before saving your work.

Besides all this, Lotus HAL gives 1-2-3 a number of other useful and powerful new features—like spreadsheet auditing and the ability to link cells or ranges between worksheets.

One obvious benefit of all this is that you save time. This is what led Business Software to say, "...(Lotus) HAL gives users the ability to move through 1-2-3 at least twice as fast."

And what does that savings in time mean to a business person? It means you're more powerful, more productive, more effective than ever before.

Make yourself more powerful, and buy yourself Lotus HAL. You'll find it at your Authorized Lotus Dealer, for just $150.* Or, you can call us directly at 1-800-345-1043 and ask for Product QA-1377, or ask for QA-1385 to receive more information about Lotus HAL. See? Everything with Lotus HAL begins with a simple request. **Lotus HAL**

Requirements: Lotus HAL is a memory resident program that requires 1 2 3 Release 1A, Release 2, or Release 2.01 for personal computers from IBM** COMPAQ and AT&T, plus 1 2 3 certified compatibles, two disk drives, DOS 2.0 to 3.1, 512K RAM. Please refer to your 1 2 3 package or 1 2 3 documentation for appropriate hardware configurations and DOS requirements or consult your dealer. **Lotus HAL does not operate with 1 2 3 for IBM PCjr, or IBM PC Convertible or Release 1A for the IBM 3270 PC. When you purchase Lotus HAL directly from Lotus, take your first 30 days to try it. If after 30 days Lotus HAL does not perform as described and you've purchased it directly from Lotus, we'll gladly give you a full refund.

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Lotus HAL is distinguished from HAL which is a trademark of Quintel for its Hotel And Leisure software.

*Suggested Retail Price (Plus Sales Tax)

highly useful. You can install it in modules to reduce RAM requirements, and it doesn't use very much disk space. In addition, it is quick and generally predictable in its response with virtually any software package. *SideKick* doesn't offer as many features as, say, *Metro*, but it is much lighter on its feet and supports the utilities most users are likely to need most often. **—Tom Badgett**

TeamWork

TeamWork, from Interface Technologies Corp., takes its name from its interface: it uses two windows, designed to work as a team to enhance your productivity.

In practice, the dual-window approach of the $65 *TeamWork* package sometimes proves useful—when using the dialer in one window while you have a list in the list manager in another window, for example. But many of the tasks you use desktop organizers for have no need for this sort of design, and it becomes superfluous after a while. The most efficient way to design multi-use tasks is to optimize for them, such as by making a phone list for the dialer that is compatible with the list manager, so that the view of the data is the one you need at that time.

■ If loaded last, *TeamWork* rewards you by letting you unload it from memory if necessary.

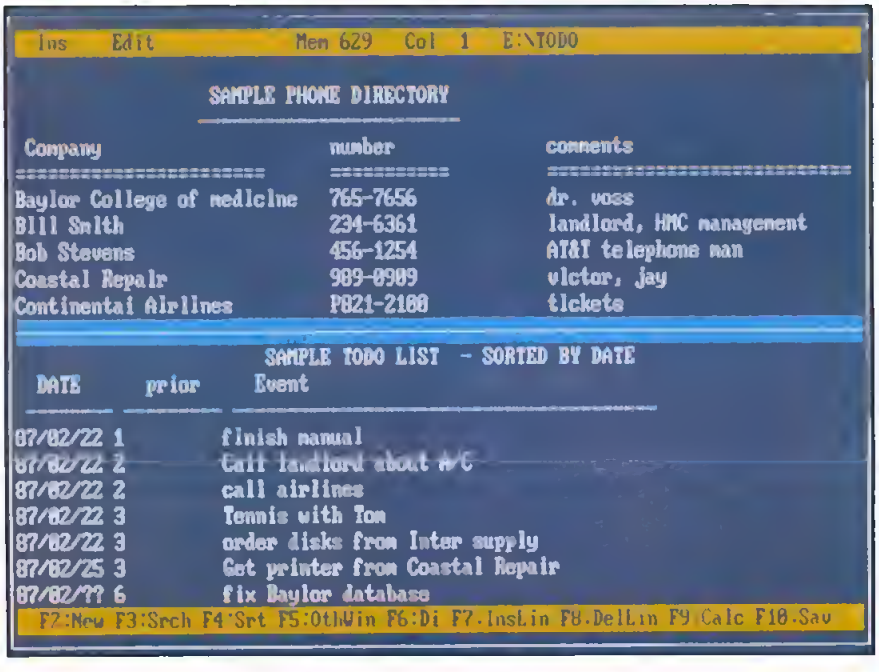
TeamWork has a full complement of the required basics: a four-function calculator plus percents, a calendar good from 1980 to 2099, a file directory, ASCII table, screen-capture and cut-and-paste facilities, dialer, list manager, and editor. It starts up with the phone list in the top window by default, as if it assumes that the main thing you need a computer for is to dial your telephone. Nevertheless, you may bring in other functions as needed and Zoom to one window if you wish.

If you want to integrate the calendar with an appointment list, you must use the list manager in the other window. The dialer has a few nice touches. You can use the F6 key to dial a number on any line, the F3 key to search for a name and dial the number on the same line, and use any key but the Spacebar to redial.

The list manager has built-in Sort capabilities. The editor works with any ASCII file with a maximum line length of 77 characters, up to 660 lines in the 115K-byte *TeomWork* version. The available file size is a changeable parameter and determines the size of *TeamWork* in memory. If you want a small version (up to 225 lines), you can get away with 81K. For 855 lines, the bill goes up to 140K. Both versions are available preconfigured with batch files. *TeomWork* creates a backup file when you begin editing. You can print a file, a block of text, and the calculator tape.

TeamWork expects to be the last TSR loaded, and it rewards you if it is loaded last by allowing you to unload it from memory if necessary. The invocation keystroke combination is Alt-T. The emerging standard to resolve keystroke conflicts with the foreground program is to use the keystroke in question twice if what you want is the resident program; *TeamWork* has implemented this attractive idea.

TeamWork's features are adequate but not exceptional, and it should do a better job of integrating functions. Essentially, not that much sets it apart from its competitors. **—Merv Adrian**



TeamWork's two windows were designed to work together. This approach can be helpful when, for instance, you have the phone dialer in one window ond your to-do list in the other. However, many tasks that require o desktop orgonizer have no need for such o design.

PC MAGAZINE FACT FILE

TeamWork
Interface Technologies Corp.
3336 Richmond Ave.
Houston, TX 77098
(800) 922-9049
(713) 523-8422 (in Tex.)
List Price: $65

Requires: 115K RAM beyond other system requirements, one floppy disk drive, DOS 2.0 or later, Hayes or Hayes-compatible modem for auto-dial feature.

In Short: Adequate but not exceptional TSR program with dual-window approach; lacks smooth integration of features. Not copy protected.

CIRCLE 661 ON READER SERVICE CARD

WordPerfect Library

Just one look at *WordPerfect Library*, from WordPerfect Corp., tells you that you're dealing with a different animal. It's the only desktop organizer I've seen that's a slipcase-bound, three-ring-binder package. The keyboard template confirms its distinctiveness. Clearly, this impressive package offers more than the typical desktop organizer.

Two disks accompany the $129 package, one labeled Library and one labeled Macro Editor/Program Editor. The two editors are part of the Library, which is really a collection of programs built around the 40K-byte Shell program. The Macro Editor requires 120K and the Program Editor 90K, but it's unlikely that you'd keep them resident except in special situations. The Shell provides the cut-and-paste functions and memory management of the other tools: Calculator, Calendar, File Manager, Notebook, and a "shoot-'em-up" game called Beast.

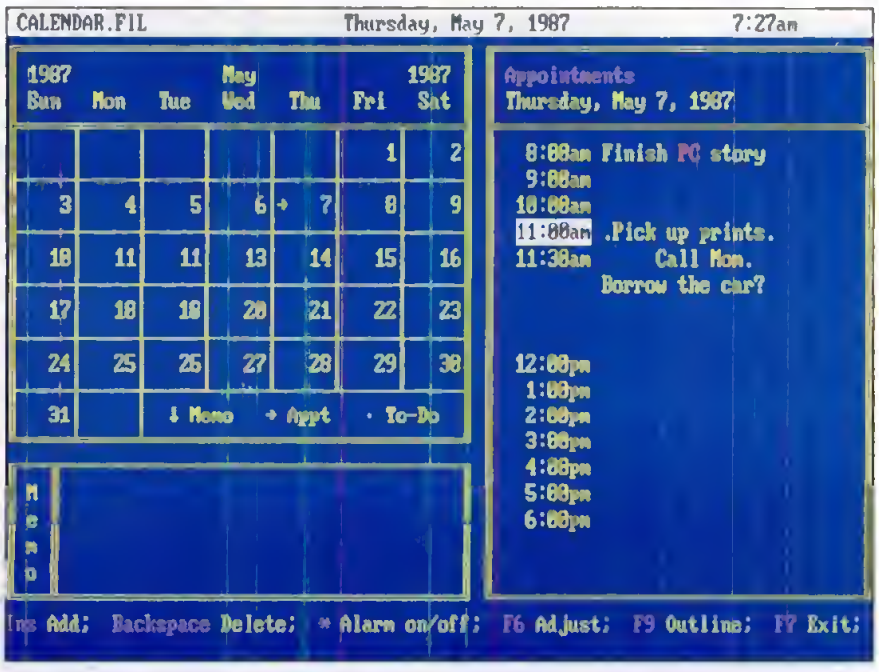
WordPerfect Library is intended to be an integrator; the Shell supports the Lotus/Intel/Microsoft expanded memory specification, and since you can add WordPerfect Corp.'s *WordPerfect* word processor and *MathPlan* spreadsheet for 410K, you can be totally integrated in the *WordPerfect* environment, with built-in optimization. However, you can use *WordPerfect Library* without these two programs. The Shell has some innovative features: a screen copy and retrieve function, an attractive memory map, and a Set-up menu for modifying the menu itself with ease. The Shell documentation is superb (especially if you use *WordPerfect*), with examples for clipboard users, a discussion of memory use, and more.

WordPerfect Library's Calculator is of a different caliber from those of the other TSR packages; it makes even *Partner-PC*'s calculator look insignificant. In addition to financial functions like annuities, interest, and profit margin, it handles scientific computations, including logarithmic, exponential, and trigonometric calculations. A set of programmer functions includes complements, shift-and-rotate, and Boolean operators (AND, OR, XOR, MOD). In typical *WordPerfect* style, the well-designed Calculator's on-screen display makes functions easy to find.

The Calendar comes with a bewildering array of options that program customizers will love. It features the usual alarms, to-do list, and appointment file and adds marvelous touches like date and word searches, including wildcard characters in the word search feature, bold and underline for items in the lists, and the ability to merge separate calendars to detect and resolve scheduling conflicts.

The File Manager is an attractive full-screen tool that includes search, rename, lock, copy, delete, look, select by pattern, sort for changing the display, and mark (to select multiple files for certain operations) options. Surprisingly for such an advanced tool, it has no Move function to move files among directories.

The Notebook is a list manager, file manager, address book, and telephone book plus dialer all in one. It has two display formats: a list, and a form that looks like an index card. The Notebook files are *WordPerfect* secondary merge files, so they have extended usefulness if you use *WordPerfect* as well. The Notebook gives you a number of easy ways to get to the record you wish. Pressing the Enter key brings up the forms view, which supports a wealth of options for editing, adding, deleting, inserting dates, and



The calendar included with WordPerfect Library *features the usual alarms, to-do list, and appointment files, and adds out-of-the-ordinary features like date and word searches. It can also merge separate appointment calendars, allowing you to detect and resolve scheduling conflicts.*

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

WordPerfect Library
WordPerfect Corp.
288 W. Center St.
Orem, UT 84057
(801) 225-5000
List Price: $129
Requires: Varies according to functions kept resident; 110K RAM for the Shell program plus DOS; 128K RAM for Macro Editor; 90K for Program Editor; 384K RAM to load Calendar, Calculator, and Notepad, for example, along with either *WordPerfect* or *MathPlan*; 640K RAM to load and keep every part of the Library resident beyond other system requirements. Two disk drives or hard disk, DOS 2.1 or later.
In Short: An impressive TSR program with two disks, Library and Macro Editor/Program Editor. Really a collection of desktop organizers built around the 40K Shell program; intended to be an integrator when used with *WordPerfect* and *MathPlan*. Not copy protected.

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Vincent Puglia PC Magazine Vol. 6 #3

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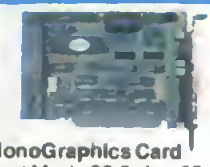

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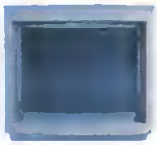

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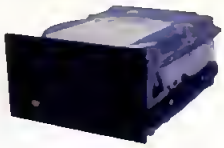

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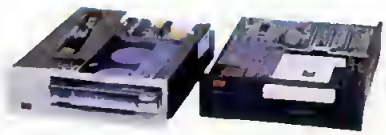

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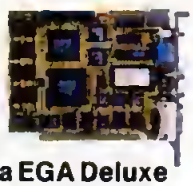

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WordPerfect Library is second to none, not only for *WordPerfect* and/or *MathPlan* users, but for those who need the best TSR calculator on the market.

—Merv Adrian

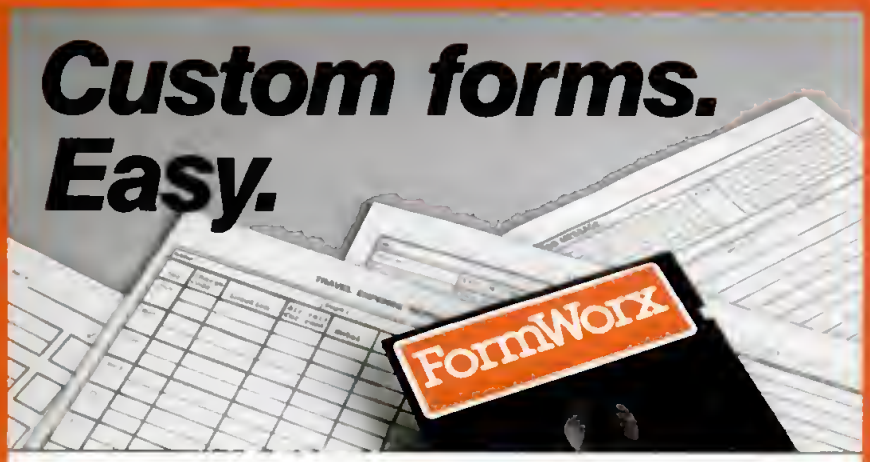
Merv Adrian is project manager at a major New York brokerage firm and chairman of the New York PC User Group's micro-to-mainframe SIG group. Tom Badgett is a computer industry researcher and freelance writer based in New Jersey.

PC MAGAZINE EDITOR'S CHOICE

- **Metro**
- **WordPerfect Library**

Lotus's $85 Metro *and the $129* WordPerfect Library *are the most full-featured of the products reviewed. While these packages operate very well as standalone products, they offer the added benefit of smooth integration with other programs from their respective vendors:* Metro *integrates with and has the look and feel of* 1-2-3, *and* WordPerfect Library *works smoothly with* WordPerfect *and* MathPlan. *However, if you need financial functions, you'll want* WordPerfect Library, *which offers the more impressive calculator.* Metro, *on the other hand, offers superior communications capabilities and a versatile phone directory.*

Still, SideKick *has aged rather well. Its hex/decimal/binary calculator, full-featured* WordStar-*like editor, bulletproof construction, and sturdy cut-and-paste abilities make it the programmer's TSR of choice. In fact, its NotePad is so good that lots of tech types use it as their program editor. And* SideKick *boasts the friendliest interface on the market.*



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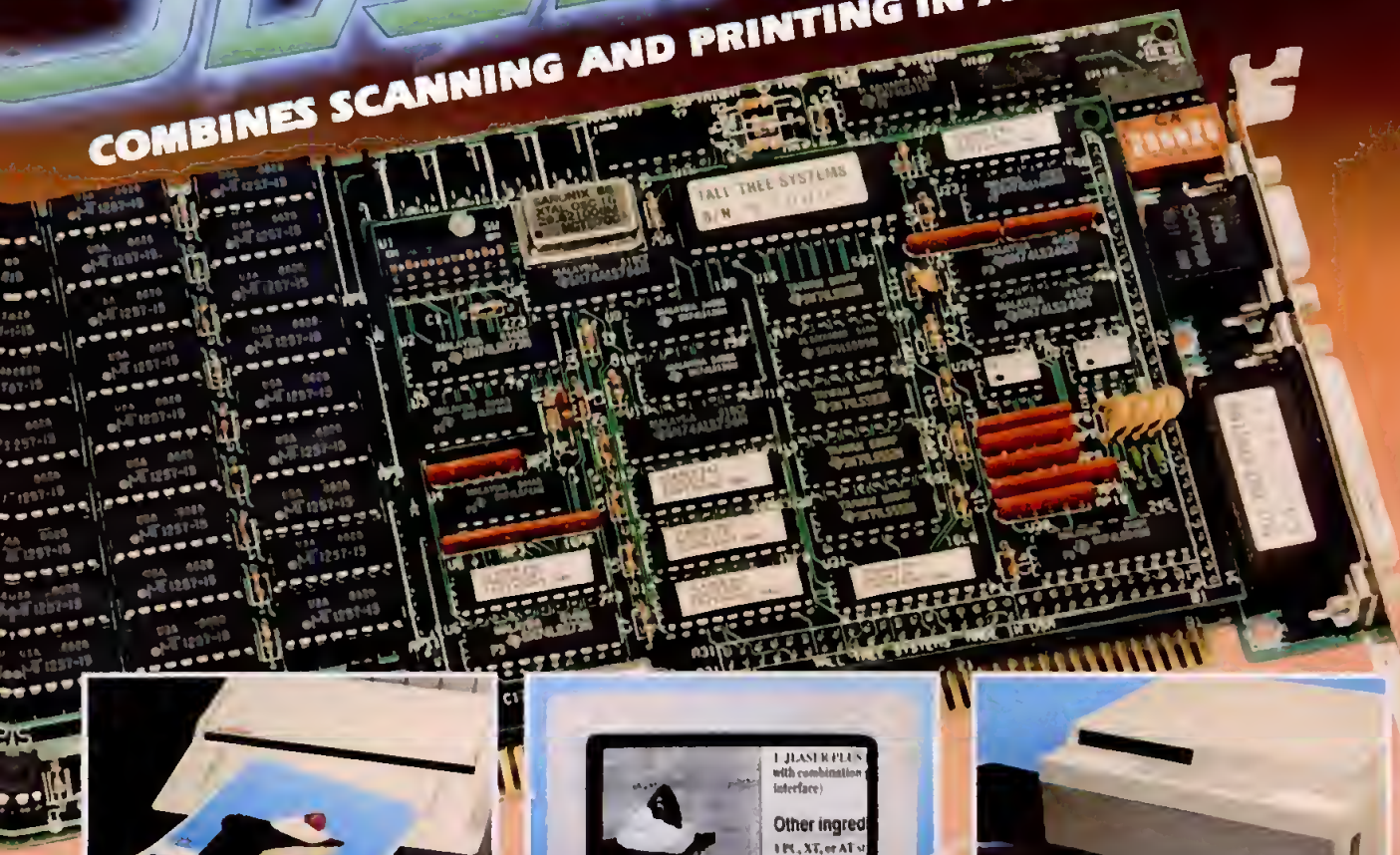

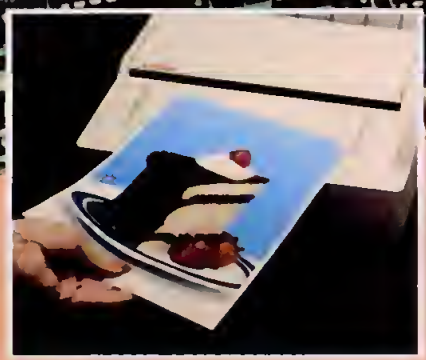

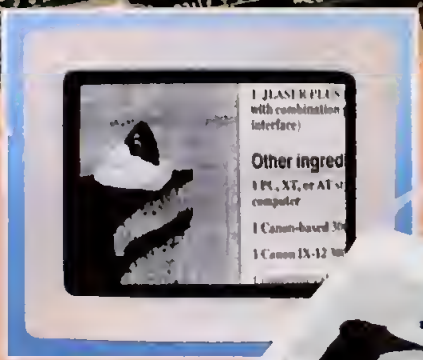

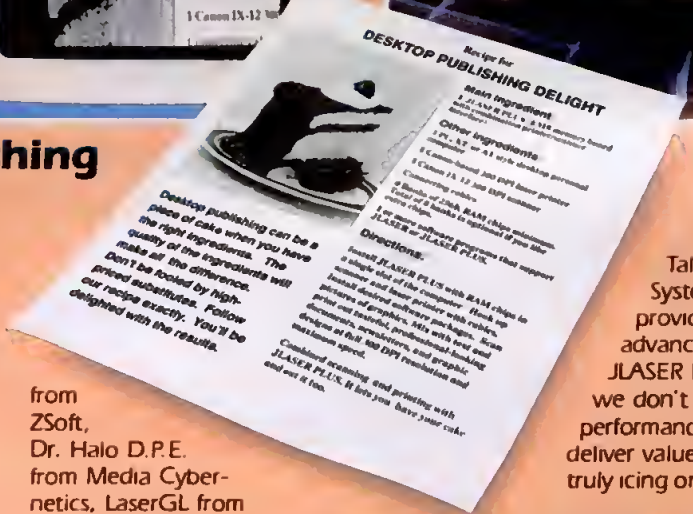

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TAKING YOUR AT'S MEMORY TO THE MAXIMUM

A multifunction board, equipped with an assemblage of chips, "piggybacks," daughterboards, and modules, can carry your machine right up to its 16-megabyte limit.

CRASH! No, it's not the sound of metal striking metal in a traffic pileup. But if your AT were the autobahn, the sound you hear would be caused by your BMW/spreadsheet slamming full tilt into an unnatural, performance-shattering wall: the MS-DOS 640K-byte memory limit.

Although the AT has a true 16-bit microprocessor in the form of the Intel 80286, and the potential to address up to 16 megabytes of memory, its roots (and, unfortunately, its operating system) hark back to the very first IBM PC. A fine blue-blood lineage, perhaps, but one fraught with enough genetic anomalies to make Gregor Mendel roll over in his grave.

When first conceived, the PC's 640K-byte memory limit seemed enormous—ten times what most of the competition could offer. RAM chips were also terribly expensive, and most of the original applications were moved up from the RAM-deficient CP/M world.

Quickly, however, many programs were developed that utilized the additional memory and put the PC at the low end of the minicomputer realm in terms of computing power. Indeed, many applications today are being ported downward from their minicomputer beginnings to the PC family, but 640K does not a VAX make.

The earliest attempts to stuff more memory into the PC were extended memory boards. These proved to be about as useful as the memory beyond 640K bytes found on a number of AT-compatible systems currently being manufactured—use it for the VDISK virtual disk (RAMdisk) emulator or forget it.

AT Multifunction Boards: Summary of Features

(Products listed in ascending price order for 512K)

Product Manufacturer	List price with minimum memory	List price with maximum memory	Maximum memory on daughtercard	EMS memory	EEMS memory
JRAM AT-3 Tall Tree Systems	$439 (512K)	$709 (2 Mbytes)	None	●	○
Smartpack II American Micronics Inc.	$495 (512K)	$839 (1.5 Mbytes)	2 Mbytes	○	○
IDEASupermax/EMS IDEAssociates Inc.	$575 (512K)	$975 (1.5 Mbytes)	2.5 Mbytes	●	○
Grende Byte Plue STB Systems Inc.	$579 (512K)	$1,495 (2.5 Mbytes)	None	●	○
Overachiever Plus Computer Peripherals Inc.	$595 (512K)	$895 (1.5 Mbytes)	1.5 Mbytes	●	○
RAMpage 286 AST Research Inc.	$695 (512K)	$1,495 (2 Mbytes)	None	○	●
Elite 16 Profit Systems Inc.	$695 (512K)	$1,000 (1 Mbyte)	None	●	●
PC **Advantage Premium** AST Research Inc.	$745 (512K)	$945 (1 Mbyte)	1 Mbyte	○	●
Above Board PS/286 Intel Corp.	$745 (512K)	$1,195 (2 Mbytes)	2 Mbytes	●	○
PC **Eccell** Orchid Technology Inc.	$745 (512K)	$895 (1 Mbyte)	2 Mbytes	●	○
NetRAM Pure Deta Ltd.	$499 (128K)*	$699 (1.152 Mbytes)*	None	○	○

PC—Indicates Editor's Choice ●—Yes ○—No
*Sold in two configurations only: 128K and 1.152 Mbytes.

As with most things in this world, a better mousetrap was to be had, and a number of hardware and software vendors saw the opportunity to put right what Big Blue had done. Operating systems with the ability to crack the 640K-byte barrier exist in the form of Xenix and Concurrent PC-DOS, but these have met with limited acceptance. (IBM's own OS/2 has been announced but awaits further scrutiny, along with compatible applications, before judgment can be passed.)

All of this leads us to memory boards for the AT. Many of these boards allow us to use our favorite MS-DOS software packages along with acres of memory chips. Combine them with operating environments (like *DESQview*), and the AT will finally live up to its full potential.

For this review, we looked at ten multifunction boards designed for AT use. They include: American Micronics' Smartpack II, AST Research's Advantage Premium and RAMpage 286 boards, Computer Peripherals' Overachiever Plus, IDEAssociates' IDEASupermax/EMS, Orchid Technology's Eccell, Profit Systems' Elite 16, Pure Data's NetRAM, STB Systems' Grande Byte Plus, and Tall Tree Systems' JRAM AT-3. We ran them through the PC Labs benchmark tests and compared their performance with that of the industry standard, Intel's Above Board PS/286, also reviewed here.

Creative sorts who want to configure their own board can purchase many of these boards without memory at prices ranging from $395 to $595. More often they are sold with 512K or 1 to 2 megabytes of memory and can be expanded by adding chips and "daughter" or "piggyback" boards. Profit Systems lets you take its Elite 16 board up to 16 megabytes, but that also takes the basic price of $695 up to $4,945.

EXTENDING MEMORY These boards provide additional memory, but the system can utilize it in very different ways. At the low end of the spectrum are extended-memory boards that interface directly with the 80286's memory address bus. They appear as just an extension of the memory on the motherboard. Once the memory to-

Standard serial ports	Standard parallel ports	Optional serial ports	Game port	Fits in XT 286	Other features	Software included
1 (DB-9)	●	None	None	○	Spooler, RAMdisk	None
2 (DB-9)	●	None	Standard	○	None	None
2 (1 DB-9, 1 DB-25)	●	1 (DB-25)	None	○	Spooler, RAMdisk	None
1 (DB-9)	●	None	None	○	Spooler, RAMdisk	None
2 (1 DB-9, 1 DB-25)	●	None	Standard	●	Cache, spooler, RAMdisk	None
None	○	None	None	●	Clock control, spooler, RAMdisk	*DESQview*
1 (DB-9)	●	1 (DB-9)	None	●	None	None
1 (DB-9)	●	1 (DB-9)	Optional	○	Clock control, RAMdisk	*DESQview*
1 (DB-9)	●	None	None	●	RAMdisk, spooler, clock control	None
1 (DB-9)	●	None	None	○	Clock control, cache, spooler, RAMdisk	None
1 (DB-9)	●	None	None	○	None	None

tal climbs above 640K bytes, however, MS-DOS raises its ugly head, closes its eyes, and ignores the rest.

This is not to say that extended memory is a waste. It can be used as a virtual disk to speed up disk-access-intensive applications. MS-DOS treats the RAMdisk as just another logical device name, but because all of the manipulations are purely electronic, there is no lag time, whereas a disk drive head would be thrashing about looking for the appropriate data sector. Just remember to copy the files from the RAMdisk to a real one when you're finished, because when the power goes out, so does anything stored in memory.

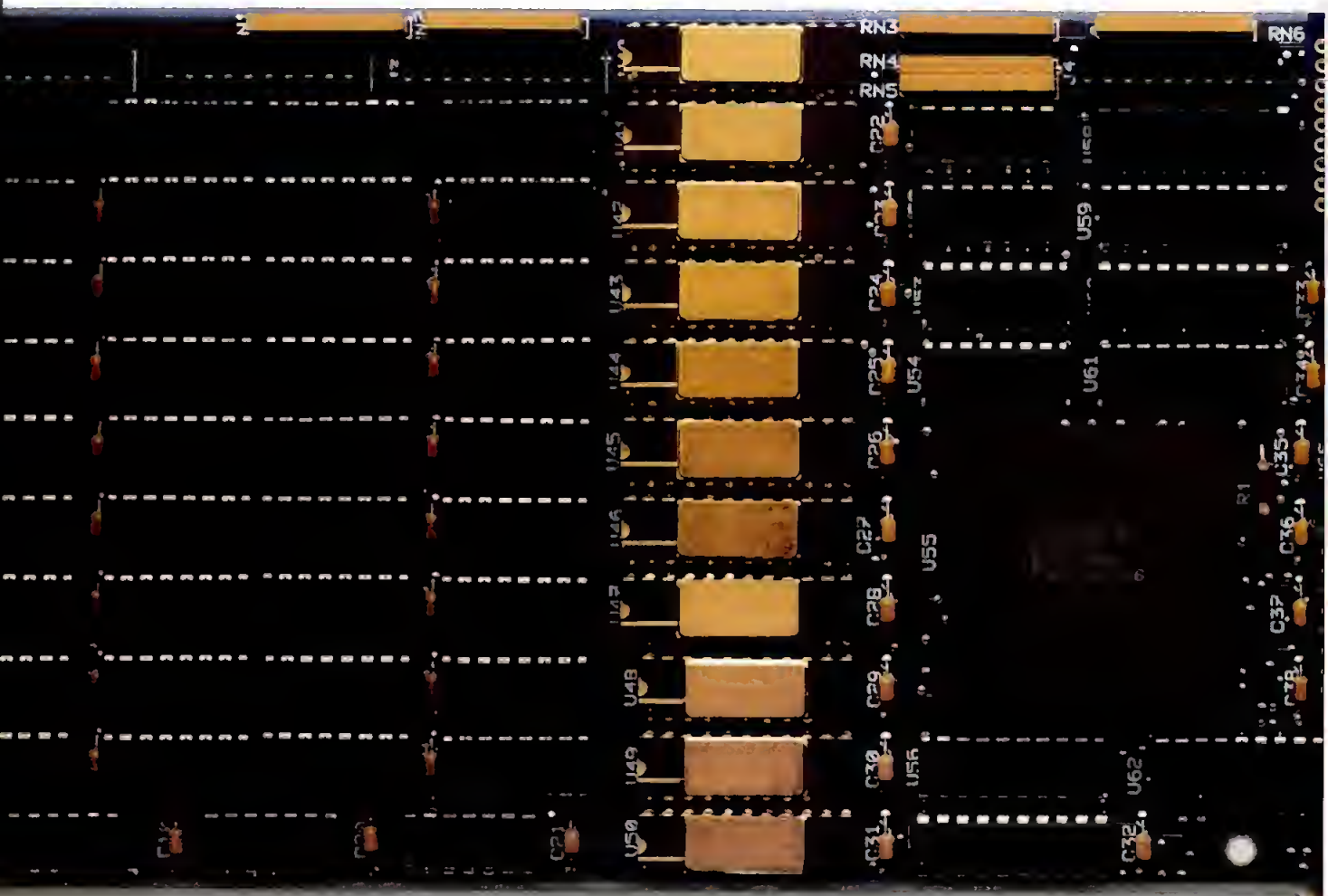
Printer spooling is another desirable use for extended memory. There's absolutely nothing fun (or productive) about waiting for a 40-page document to crawl out of a letter quality printer while the AT sits there doing nothing else. By setting up a print spooler, the entire document can be placed in the extended memory, and the computer is allowed to run other software as the printer operates at its leisure.

Finally, extended memory is the route to take for systems running under Xenix or Concurrent PC-DOS, operating systems that fully exploit the microprocessor's 16-megabyte address limit. You'll have to search hard to find software that runs under Xenix, but many MS-DOS programs can be run as tasks under Concurrent PC-DOS—and more than one may be run at the same time.

EXPANDING MEMORY In 1984 Intel, Lotus, and Microsoft banded together to come up with another solution to the MS-DOS memory limit. The result of this brainstorming is the expanded memory specification (EMS). Boards using this system are both architecturally and functionally different from their extended-memory counterparts.

With EMS boards, a device driver is installed in the system's main MS-DOS memory during the boot process by the CONFIG.SYS file. The driver then oversees access to the expanded memory by software written to utilize it, such as Lotus's *1-2-3*, Release 2, *Symphony* 1.1, and *Framework II*. Although the memory is actually treated as separate 64K-byte

How to 386



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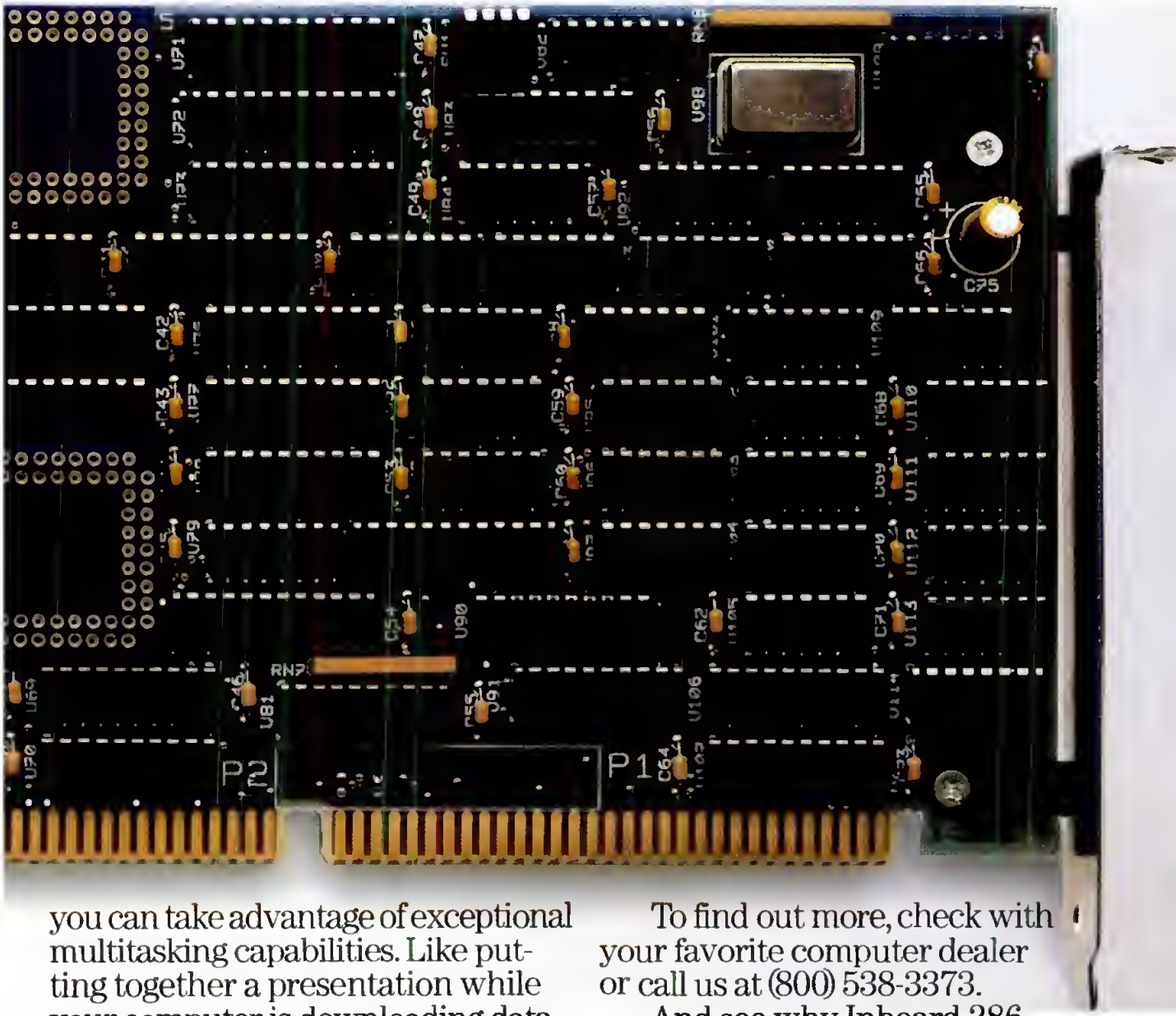

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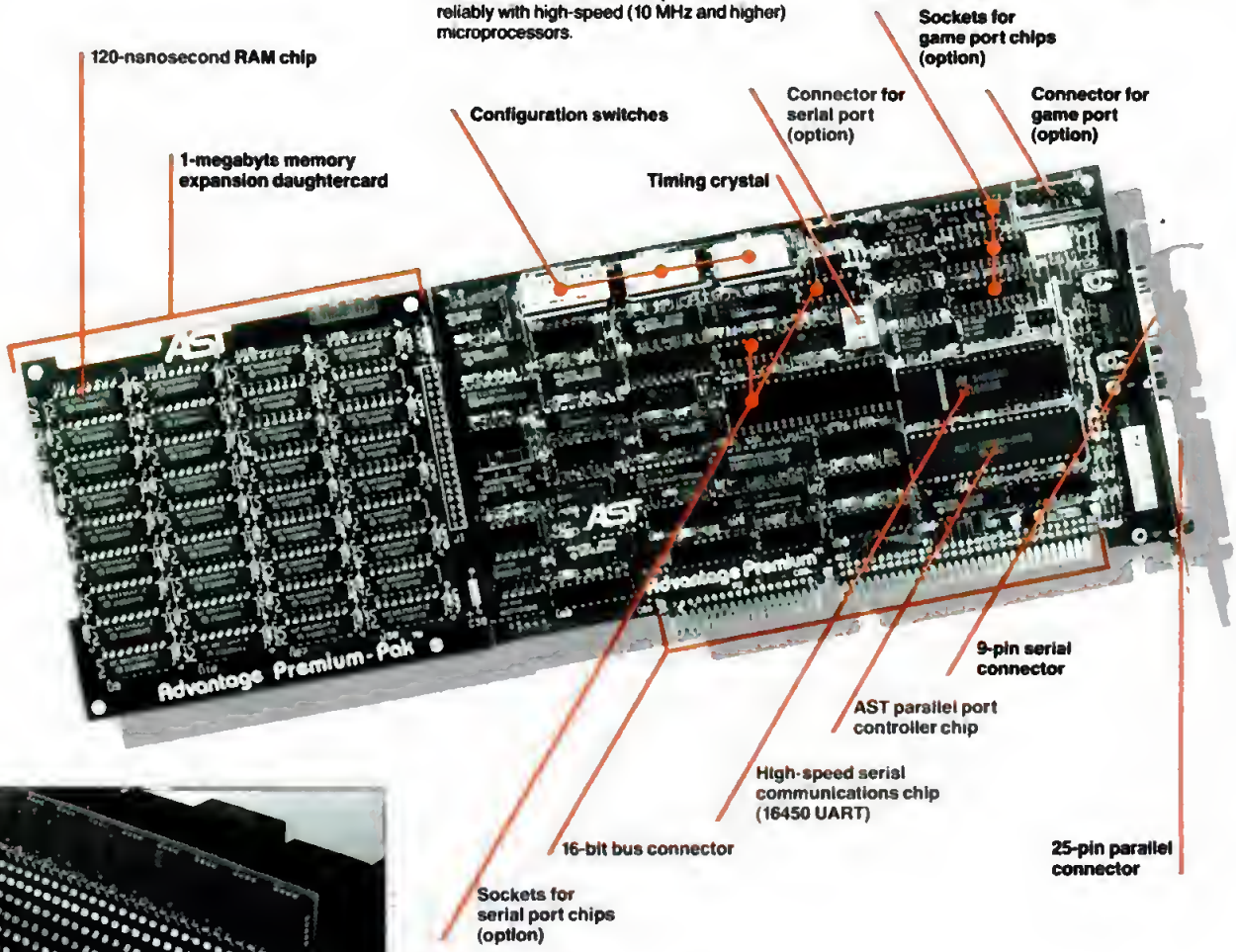
CIRCLE 511 ON READER SERVICE CARD

Multifunction Board Architecture

AT-compatible multifunction boards are designed to push the computer's memory past the 640K-byte limit of MS-DOS. The architecture of these boards, like that of the AST Advantage Premium board, shown here, supports extended memory, expanded memory (EMS), and enhanced expanded memory (EEMS). The boards also include serial communications, parallel printer ports, and, very often, game ports.

- The **1-megabyte memory expansion** daughtercard (on the board's left) doubles the amount of extended or expanded memory on the board.
- The individual **RAM chips**, rated at a speed of **120 nanoseconds**, give you faster speed of operation (as shown on the PC Labs Extended Memory benchmark tests).
- The **configuration switches** (on the board's top center) set parameters for extended and expanded memory, as well as for serial and parallel ports.
- The **timing crystal** ensures the accuracy of the board's timing circuits.
- The **16450 UART** is a **high-speed** RS-232C **serial communications chip** that works reliably with high-speed (10 MHz and higher) microprocessors.
- The **connectors** at the rear of the board are standard IBM PC AT–type connectors to peripherals such as printers and modems.
- Below the UART is an **AST parallel port controller chip.**
- The **16-bit bus connector** fits into comparable slots on the IBM PC AT and compatible computers.
- The large empty socket (see **sockets for serial port chips**) on the board is for an additional 16450 UART, which, along with two other support chips, gives you an additional RS-232C serial port.
- A **game port** is available as an option, but it requires that you also add three chips to sockets on the board.



Profit Systems' **Elite 16** multifunction board uses SIMM (single in-line memory module) strips to expand memory to as much as 16 megabytes. Its packaging lets you insert a strip of RAM chips into sockets on the board.

blocks, the switching operation is transparent when running the application—as far as you can tell, your 2-megabyte spreadsheet is a single entity.

Finally, there's the enhanced expanded memory specification (EEMS) found within EMS. In our review we found it only on AST's Advantage Premium and RAMpage 286 boards. While standard EMS boards can use the additional memory only for data storage, EEMS boards (when used with an operating system enhancement program, such as Quarterdeck Office Systems' *DESQview*) also allow programs to execute in the expanded RAM area. EEMS lets several programs all run simultaneously and switch from foreground to background instantly. A communications program could run as a background task, downloading a file from another computer, while another application, such as a word processor, churns along on the screen. You get true multitasking without having to sacrifice your hard-earned MS-DOS software collection.

All of the boards we reviewed, living up to their multifunction monikers, offer capabilities beyond memory expansion. Most common are serial communication and parallel printer ports, although video display adapters are just beginning to appear. PC multifunction boards normally include clock/calendars, but that function was built into the AT, and you won't necessarily find it on the boards reviewed here.

The main chip used for RS-232C communications is a UART (universal asynchronous receiver/transmitter). As a transmitter, the chip changes parallel data from the microprocessor into serial bits for transfer to peripherals like modems and printers. As a receiver, the chip changes serial data from the peripheral into parallel data for the microprocessor. The multifunction boards use either an 8250 UART or the newer, faster 16450 chip.

The 256K-bit RAM chip is found on all of these products. While the newer 1-megabit chip would allow more memory on a single board, it's just not cost-effective yet. Most boards use chips rated for 150-nanosecond operation, which is adequate for the usual 8-MHz AT or compatible. For the hyperactive 12-MHz clones, however, look for 120-nanosecond RAM chips, or there could be some trouble.

Most of the boards use the extra height in the AT cabinet to put more memory on a single board. This would preclude their use in the smaller IBM PC-XT Model 286.

Whatever you do, resist the urge to save a couple of bucks and try to make do with one of the older memory boards (such as the AST SixPak) designed for the original PC. In the event that they would work at all (most won't, owing to differences in memory addresses), their 8-bit bus structure would severely limit data throughput to the CPU. You spent plenty for the extra power offered by the AT, so don't waste money on products that don't do it justice.

PC MAGAZINE FACT FILE

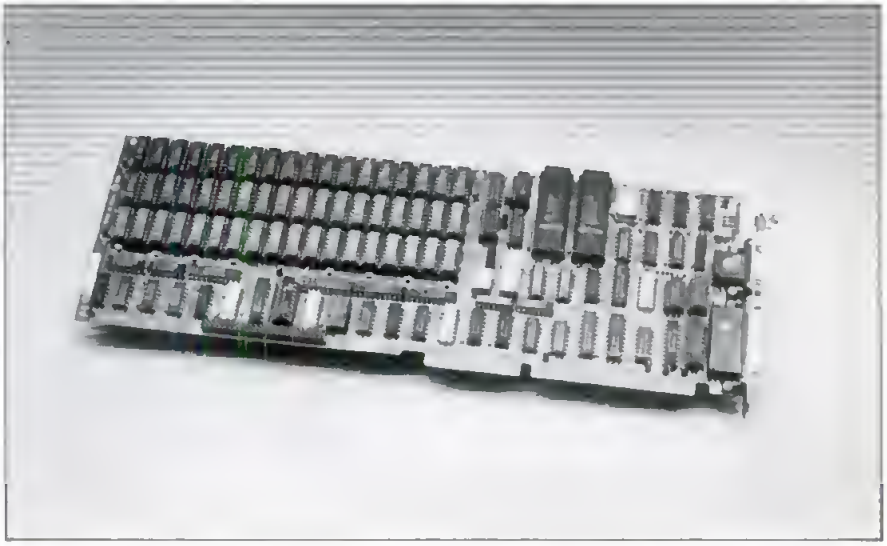
Smartpack II
American Micronics Inc.
17831 Skypark Circle, Suite C
Irvine, CA 92714
(800) 443-6315
(714) 261-2428
List Price: No memory, $395; with 512K RAM $495; with 1.5 Mbytes, $839; 1.5-Mbyte board with 2-Mbyte piggyback board, $1,499.
Requires: AT-size 16-bit slot
In Short: A functional, if not exceptional, extended memory multifunction board. Configuration by way of interchangeable PAL chips is something of a disadvantage.
CIRCLE 685 ON READER SERVICE CARD

AMERICAN MICRONICS INC.

Smartpack II

American Micronics' Smartpack II multifunction board allows your AT much of the power that God (or at least IBM) intended it to have. It also promises compatibility with 10- and 12-MHz systems, plus parallel and serial ports. What you won't find is Lotus/Intel/Microsoft expanded memory specification support or any software. We're talking strictly plain-Jane here, but the price is reasonable. A board with 512K bytes of memory lists for $495; one with 1.5 megabytes goes for $839.

The main board is of decent, if not exceptional, quality. A couple of wire jumpers on the underside make one wonder if the designers forgot something the first time around (even though this one was marked "Revision D"). Enough sockets are provided to populate the board with 1.5 megabytes of memory chips. Also available (but not tested for this review) is a daughtercard that raises maximum memory to 3.5 megabytes. Our review sample was populated with 100-nanosecond 256K-bit RAM chips that should allow the



American Micronics' Smartpack II multifunction board comes with parallel and serial ports and is compatible with 10- and 12-MHz systems, but it offers no support for EMS and comes with no software, not even a RAMdisk.

Photographs: Thom O'Connor

Smartpack to run on 12-MHz systems.

Being of full AT-height, this board will not accommodate the needs of the IBM PC-XT Model 286 owner. No mention is made in the documentation of its suitability in the latest breed of 80386 machines.

In keeping with its high-speed theme, the Smartpack utilizes a pair of 16450 UART chips. Although the older 8250 UART chips usually get the job done, they have been known to die at speeds higher than 8 MHz.

The first serial port is an AT-style DB-9 male connector, which shares the backstrap with a conventional female DB-25 parallel printer connector. The second serial port and a game port are mounted on a separate mounting strap and connected to the main board by a pair of ribbon cables.

The Smartpack's approach to configuration was unique among the boards we reviewed. It has 12 DIP switches, and a couple of jumpers are thrown in for good measure, but then there are the programmed logic array (PAL) chips. Depending on your system and its memory complement, you will have to use the appropriate PAL chip. Five different PALs are listed in the manual, but only three were supplied with the review board. Which one you will need depends on the manufacturer, amount of memory, and type of memory chips (64K- or 256K-bit) used on the system's motherboard. The introduction to the manual lists this as if it were a feature of the board (" . . . the user does not have to go through a painful routine of setting up multiple DIP switches and a number of jumper configurations for memory . . . "). I'd rather try my luck at DIP switch settings when moving the board from one computer to another.

The Smartpack's documentation is nothing to write home about. A scant 23 pages long, the unbound manual is at least small enough to fit in just about any binder you have.

Most of the other AT multifunction boards we reviewed provide at least RAM-disk or print spooler software, but none is supplied with the Smartpack board.

AMI's Smartpack might be just the ticket for owners of high-speed AT clones running under Xenix, but it comes up a bit short in offerings for the typical MS-DOS user.

AST RESEARCH INC.

Advantage Premium

Although it looks like just another AT multifunction board, AST Research's Advantage Premium proves looks can be deceiving. Sure, it has the usual I/O ports and as much as 2 megabytes of memory, but it also supports EEMS. In addition, it comes with *DESQview* software, a nifty extra that lets you turn your AT into a true multitasking computer, right now, and with plain old MS-DOS software.

DESQview is labeled as an enhancement to the MS-DOS operating system, and it accomplishes a lot of what the long-rumored new 80286/80386 operating system might provide in the future. Any program that runs under DOS 2.0 or later can be loaded into the expanded memory area, and more than one program may run at any one time. Because you still have only one "console" (the AT's keyboard and video display), only one program can appear in the foreground, while the others sit idly in the background. You can switch between tasks quickly and easily, and nothing will be lost in the process.

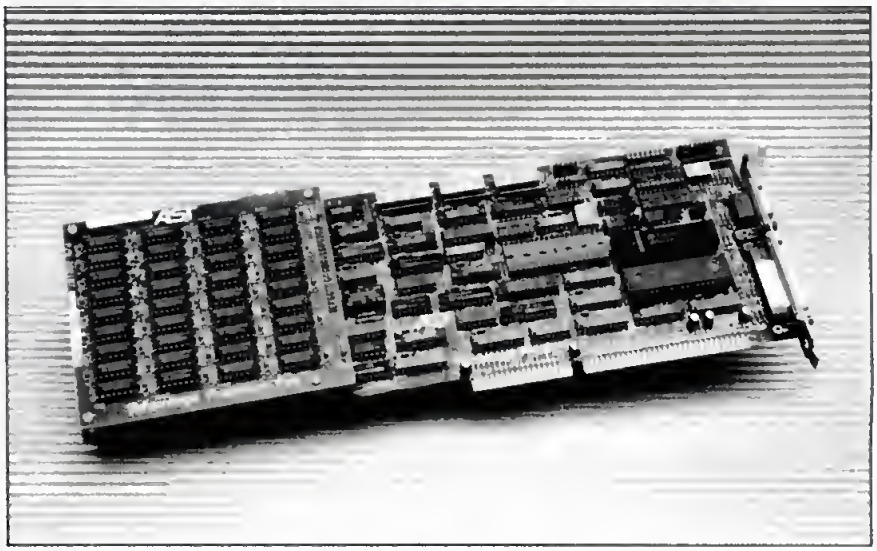
DESQview is not really a replacement for future operating systems that take advantage of the memory-addressing power of the 80286, because the programs it supports are still limited by MS-DOS. Extra memory can be used for data storage, but the executable program code is still the same old stuff. Still, this arrangement will greatly increase the life expectancy of your favorite MS-DOS software.

In terms of hardware construction, the Advantage Premium lives up to the fine reputation established by AST's venerable SixPak. Nothing shoddy here. Assembly quality is strictly first-rate, and a half-dozen IC sockets allow for future upgrading in the form of an optional game port and a second serial port.

The main circuit board has room for 1 megabyte of 256K-bit RAM chips, all fully socketed for easy replacement. The full AT-height precludes use in the IBM PC-XT Model 286. An additional 1 megabyte of memory can be added by way of a tight-fitting daughterboard. Curiously, the first 512K bytes of memory on the add-on board are soldered into place, while the second bank is socketed. Should one of the soldered memory components of the daughterboard give up the ghost, it will mean a shop visit for replacement.

The serial ports are controlled by the 16450 UART chip, the one favored by machines in the AT class.

The rear mounting strap on the Advantage Premium has a female DB-25 connector for connection to a parallel printer, and



AST's Advantage Premium has I/O ports and comes with as much as 2 megabytes of RAM. It supports EEMS and, with DESQview *software, can turn your AT into a multitasking machine running ordinary MS-DOS software.*

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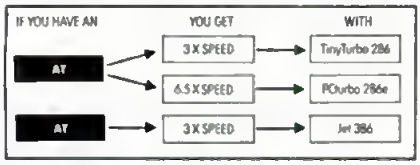
CPU	8 MHz 80286	10 MHz 80286	16 MHz 80386
RAM	8 K Cache	1 or 2 MB EMS	64 K Cache



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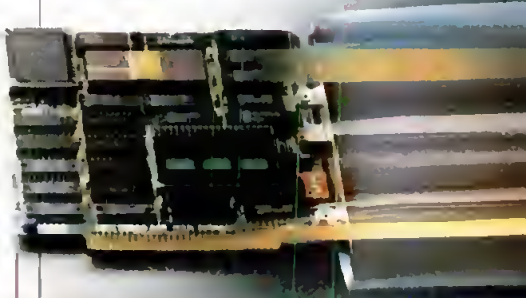
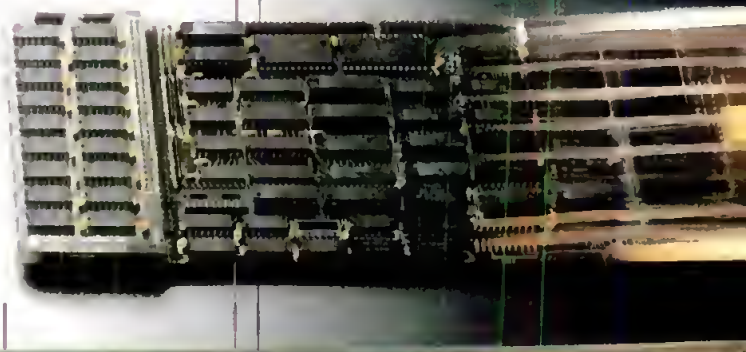
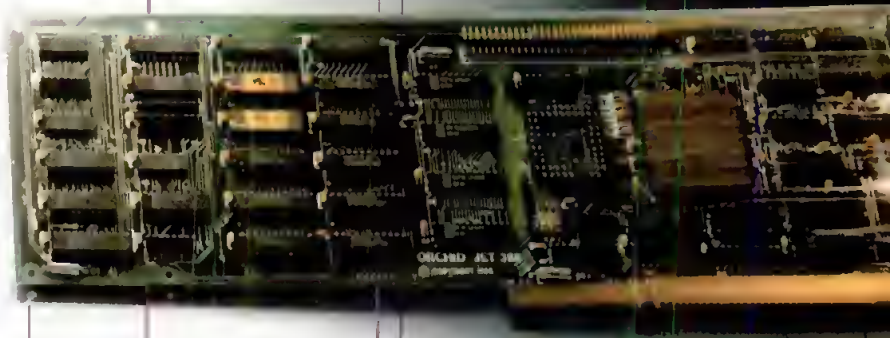


PCturbo 286e: *6.5 Times XT Speed*



Jet 386: *3 Times AT Speed*



Circle R.S. 304 for TinyTurbo 286
Circle R.S. 305 for PCturbo 286e
Circle R.S. 306 for Jet 386

3 x AT 6.5 x XT 3 x XT

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Advantage Premium
AST Research Inc.
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333
List Price: With 512K RAM, one serial and one parallel port, $745; with 1 Mbyte, one serial and one parallel port, $945; 1-Mbyte board with 1-Mbyte daughterboard, $1,495.
Requires: AT-size 16-bit slot.
In Short: AST's decision to include the *DESQview* operating system enhancement package gives the versatility of concurrent (protected-mode) 80286 operation with the current crop of MS-DOS software.

CIRCLE 684 ON READER SERVICE CARD

an AT-style DB-9 connector for a serial port. You are left to your own devices when it comes to cables to attach these: none are supplied.

One area you'll have to become intimately familiar with is the Advantage Premium's bank of configuration DIP switches—a whopping 26 of them! Add to that eight jumpers, and expect to spend an evening getting acquainted with the manual.

To its credit, AST has provided concise and well-thought-out documentation. The only fault here is that the three-ring punched pages are contained only by shrink-wrap plastic and are not in a binder. At a price of $745 for a board with 512K of memory, it would be nice if the instructions didn't scatter themselves all about the room when the package was opened.

The software provided with the Advantage Premium (in addition to the *DESQview* package already mentioned) leaves little to be desired. Pop the SuperPak disk in drive A:, type "INSTALL", and let the program do most of the configuration work for you. The program allows the available memory to be divided between enhanced and extended (using the REX.SYS extended memory emulator driver) or to back-fill the AT's standard 512K-byte configuration up to its 640K DOS limit.

Other options allow installation of a print-spooling buffer and RAM emulators for both floppy and hard disks. A clock/calendar program is also provided, but is not needed (or usable) on an AT. One might wonder why this option is supplied with a board that fits only AT-sized computers, but the truth is that AST provides this same software with other products (such as the RAMpage 286 board).

In a world of functionally similar boards for AT-class systems, it turns out that the software provided gives the Advantage Premium its real advantage.

AST RESEARCH INC.

RAMpage 286

If you've already peeked at the review of AST's Advantage Premium, you have a fair idea of what the RAMpage 286 is all about. Listing at $695 with 512K bytes of memory, it is cheaper than the Advantage Premium, and there are enough other differences for the RAMpage to fill its own market niche.

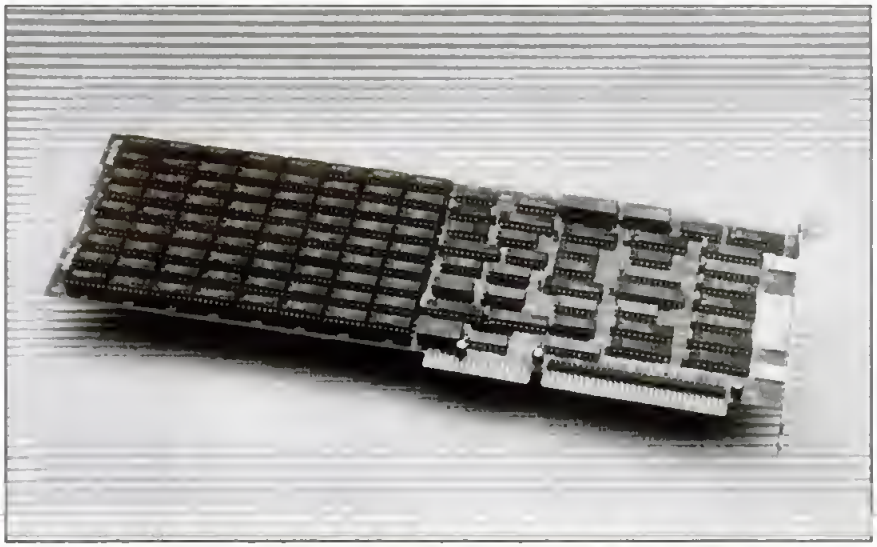
Like its larger sibling, the RAMpage 286 adds up to 2 megabytes of EEMS to your system and includes Quarterdeck Office Systems' versatile *DESQview* software. The major differences are the RAMpage 286's exclusion of I/O ports and a board that is sized to fit IBM's PC-XT Model 286 but that retains the speed of the 16-bit bus. With more and more systems (particularly the clones) putting parallel and serial ports on the motherboard, perhaps additional memory will be all that you need to add to your computer.

It might seem that the lack of I/O ports puts the RAMpage 286 in the single-function category, but that's hardly the case. Keep in mind that just about all of these boards are bundled with at least one software disk; it's the software that gives this board its multiple utility. Adding memory to your computer is one thing; giving it a useful purpose is another. AST has seen fit to package this board with a number of programs that give your system the power Intel had in mind when it designed the 80286.

Foremost is *DESQview*, a program billed as an enhancement to the MS-DOS operating system. Rather than replacing MS-DOS with a multitasking operating system that everyone seems to want (and no one is ready to deliver), *DESQview* allows your current arsenal of MS-DOS software to run concurrently within the EEMS of the RAMpage 286.

Concurrent operation allows one task to execute in the background (such as a database search or lengthy file transfer) while another runs in the foreground. It also allows you to open a temporary window on the screen to check some information stored in your spreadsheet, for example, without exiting your word processor.

DESQview can run up to nine programs concurrently in up to 5.5 megabytes of



Like the Advantage Premium, AST's RAMpage 286 adds up to 2 megabytes of EEMS to your system and includes DESQview *software, but it has no I/O ports.*

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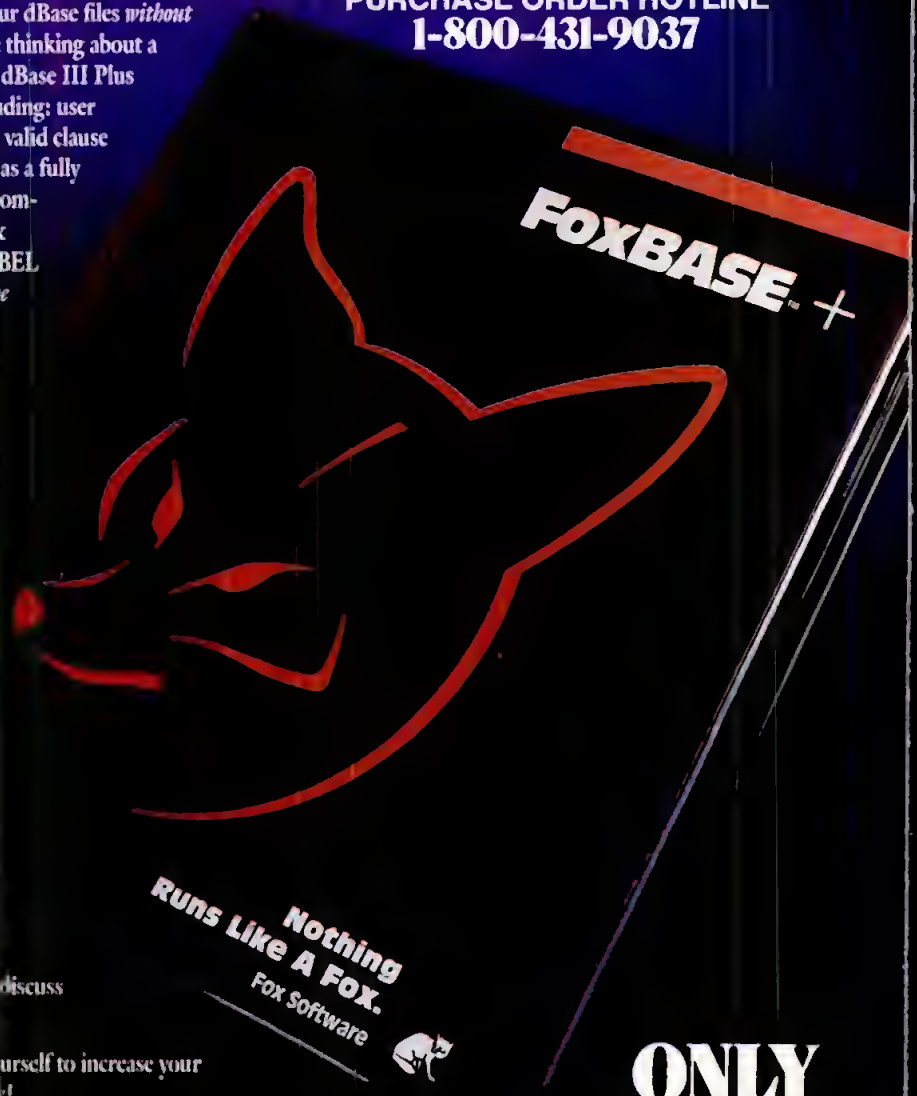

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PC MAGAZINE FACT FILE

RAMpage 286
AST Research Inc.
2121 Alton Ave.
Irvine, CA 92714
(714) 863-1333
List Price: With 512K RAM, $695; with 1 Mbyte $895; with 2 Mbytes RAM, $1,495.
Requires: PC-XT Model 286 or AT 16-bit slot.
In Short: What the RAMpage 286 lacks in I/O ports is more than made up for in the software provided. Fine construction, excellent documentation, and enhanced EMS operation make for an excellent value.
CIRCLE 683 ON READER SERVICE CARD

memory in systems with multiple RAMpage boards. If you try to install more programs than you have memory space for, unused ones are swapped out to the hard disk, which is used as virtual memory. When you require that program, it is swapped back into active memory, and another unused program swapped out.

AST also throws in its own SuperPak utility set. Installed by a series of options on the installation menu, SuperPak includes a pair of RAMdisk emulators and a print spooler. An extended-memory emulator can also be installed for software using that protocol.

The SuperDrive program emulates up to four disk drives in the expanded memory area. Why you would need so many disk drives is unclear, but it can be done.

fASTdisk is another story. It allows a portion of the expanded memory to be used as a virtual hard disk drive. The size and number of "pretend" disks is limited only by the amount of memory set aside for the purpose. With no heads to move around, fASTdisk is remarkably quick on operations that require a lot of disk access.

Finally, there's SuperSpool, which puts data going out to your printer in a portion of the expanded memory and returns control of the computer to you immediately. No longer must you wait for a large document to print while the computer does little more than occupy the desktop.

The documentation supplied with the RAMpage 286 is among the best in its class, but like many of the other offerings, it comes as loose pages bound only by shrink-wrap. Unlike some, AST's manual can be readily understood by anyone with just a basic knowledge of PC AT hardware and MS-DOS.

As for the hardware itself, there's little room for criticism. Board assembly quality appears to be very good, and the use of 120-nanosecond 256K-byte RAM chips (there's room for 2 megabytes) should ensure compatibility with AT-type systems running at up to 10 MHz. Two sets of DIP switches along the top edge of the board handle configuration options, and they can be manipulated without removing the board from its slot.

If you want to add extra memory to your computer but have no need for additional I/O ports, the RAMpage 286 may be just the way to go. The exceptional software that comes with it makes it just that much more useful.

COMPUTER PERIPHERALS INC.
Overachiever Plus

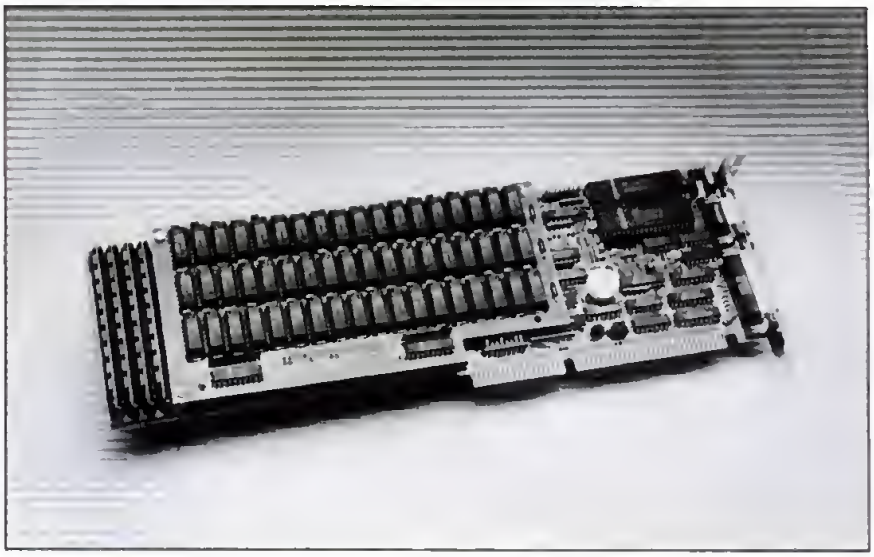
If you need to expand the memory of your PC or XT today but feel you may upgrade your computer to an AT at some time in the future, Computer Peripherals' Overachiever Plus, which lists for $595 with 512K of memory, might be just the ticket. Fully compatible with both the 8-bit and 16-bit buses, the board won't have to be discarded in the upgrade process. Unfortunately, the software supplied with it comes up a bit short.

The main circuit board displays a curious mixture of just about every manufacturing technique and peripheral function known to PC users. Its major attributes include two serial ports, a parallel printer port, a game port, a system clock, and, of course, EMS.

The Overachiever Plus differs from most of its brethren in that it can be used in a PC or XT with an 8-bit bus or in an AT with a true 16-bit bus. (In the PC installation, the second, smaller bus tab is left floating in the breeze.) This feature alone may be worth considering if you have any ideas of upgrading your system at some later time. No more throwing the baby out with the bathwater. Just keep the processor speed down to a reasonable (8-MHz) limit should you decide to upgrade.

One serial port has an AT-type DB-9 connector on the board's mounting strap. The second port has a PC-type DB-25 connected by a ribbon cable to a separate mounting tab. Both are controlled by 8250 UART chips.

Hardware configuration is accomplished by three banks of DIP switches, totaling 24 in number, and three jumpers. Changing DIP switch settings will require removing the board from the computer.



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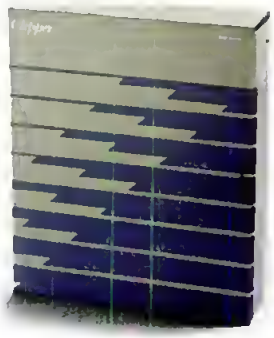

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CIRCLE 211 ON READER SERVICE CARD

PC MAGAZINE FACT FILE

Overachiever Plus
Computer Peripherals Inc.
2635 Lavery Ct., #5
Newbury Park, CA 91320
(805) 499-5751
List Price: No memory, $495; with 512K RAM, $595; with 1 Mbyte, $795; with 1.5 Mbytes $895; expansion board for 1.5-Mbyte Overachiever Plus: $175 with no memory, $495 with 1 Mbyte, $645 with 1.5 Mbytes.
Requires: PC or XT 8-bit slot, or PC-XT Model 286 or AT 16-bit slot.
In Short: A sure bet for those with mixed PC/XT/AT installation requirements. EMS memory allows for far more than just RAM-disk emulation.
CIRCLE 692 ON READER SERVICE CARD

The first 512K bytes of memory fit in standard 16-pin DIP sockets on the main board. The next 1 megabyte of memory is added by means of single inline memory modules (SIMMs, small ½- by 4-inch boards of surface-mounted device RAM chips) inserted into slots at one end of the board. An additional 1.5 megabytes of conventional DIP memory can be added by way of a piggyback daughterboard. But be careful if using the daughterboard, because it's only attached at one end and could easily break if handled improperly.

The clock (used only on PC and XT systems) is powered by a 3.6-volt nickel cadmium battery that is recharged whenever the computer is turned on.

The software for the Overachiever Plus is the Achilles' heel of this otherwise do-everything product. It attempts to perform an ambitious number of tasks, but some of the implementations are less friendly than those of the competition.

The utility disk contains a number of programs that will appeal to both PC and AT owners. Those that set and read the board's real-time clock will be of use only on PC and XT systems, while the EMS driver, printer spooler, and RAMdisk emulator can be used on any system. The disk cache memory option is somewhat more perplexing. It can only be used with drive A: and not with a hard disk drive. It speeds up disk drive random-read access by about 40 percent, but virtually all AT owners will wish this feature had been added to the hard disk drive instead.

Also included with the package is the company's own *Flip-Up Professional Deskset* program set. It attempts to do many things (and in many ways parrots the functions of Borland's *SideKick*), but it still needs a bit of polishing.

Flip-Up windows can be invoked for an alarm clock, calendar, notepad, clipboard, and two calculators (one scientific and the other financial). The feature of greatest interest, however, is Flip-Up Anything, a program that allows many other MS-DOS applications to run as RAM-resident utilities. Unfortunately, only five pages of the manual are devoted to this ambitious task. Unlike other software that accomplishes much the same job, you must specify how much memory is allocated to each task. This is indeed a useful utility, but it's not in the same league as AST's *DESQview*.

IDEASSOCIATES INC.
IDEASupermax/EMS

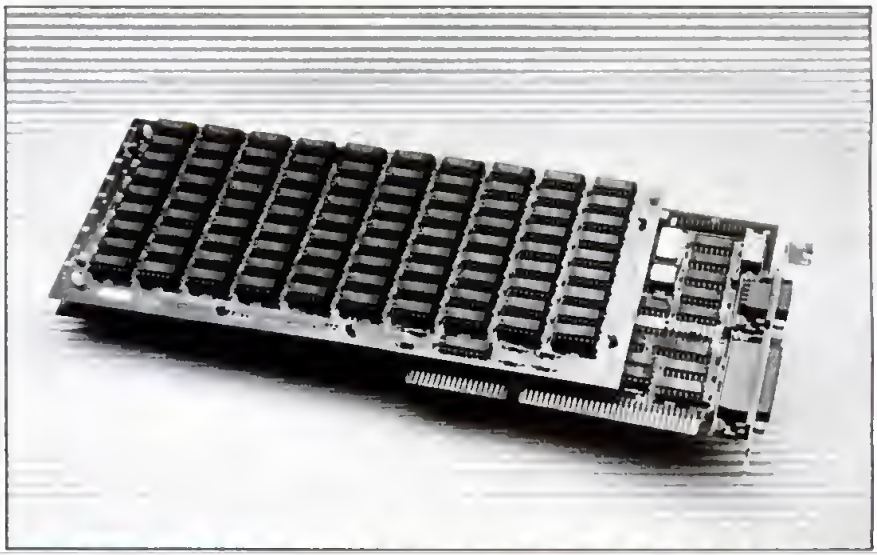
IDEAssociates has been in the quality PC-enhancement product business since 1982, supplying everything from add-in boards to disk drives and modems. The IDEASupermax/EMS AT multifunction board will boost your AT's memory to gargantuan proportions, with serial and parallel ports handling the inevitable I/O needs. It lists for $575 with 512K of memory. With daughterboard and $2,145, it can be expanded to 4 megabytes.

Visually, the IDEASupermax/EMS board conveys the sense that the designers really had their heads screwed on straight when they laid this one out. It's about as clean as you can get, with none of the all-too-common wire jumpers or cut traces. Assembly quality is strictly top-notch, but the IDEASupermax/EMS utilizes the entire height of the AT chassis and won't fit into IBM's PC-XT Model 286.

Three banks of DIP switches tailor the board for each particular installation. One set of six near the top-rear edge of the board is used to set the appropriate starting address for the board's memory. Another cluster of four configures the parallel port to answer to either the LPT1 or LPT2 logical name. The last set of eight establishes the logical names of the serial ports; the first (on-board) port can be set up as COM1 or COM2, while the optional second port is addressed as either COM2 or COM3.

The serial ports are controlled by a pair of 16450 UART chips. These should ensure compatibility with the newest breed of 12-MHz AT-clones.

Sockets are provided on the main board for the first 1.5 megabytes of memory. A



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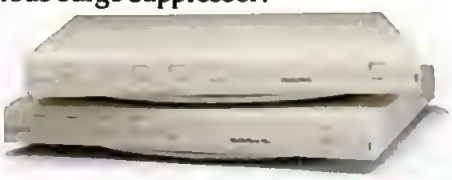

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■ AT MULTIFUNCTION BOARDS

daughtercard can be piggybacked to it, providing an additional 2.5 megabytes of memory. Our review sample was populated with 120-nanosecond 256K-bit chips, which should work in most systems.

With 90 parity-checked RAM chips on board, it's not surprising that the daughtercard is nearly as large as its parent. To keep things securely glued together, IDEAssociates attaches the smaller board by means of a 44-pin DIP header and three stand-off fasteners. Because of its size, the daughtercard covers the DIP switch bank used for configuring the serial ports. You'll have to remove it to make any changes.

The first serial port is a conventional AT-style DB-9 male connector located on the mounting strap. The optional second port uses a PC-style DB-25 connector mounted on a separate mounting strap and attached by means of a 12-inch cable to a DIP header on the board. Also included is an adapter to allow conventional PC cables to be used with the DB-9 connector.

Two floppy disks are supplied with the IDEASupermax/EMS board. One contains software that allows the board to emulate EMS. This is an important point. The IDEASupermax/EMS implements EMS in its software. The PC Labs benchmark tests used in this article were written for hardware implementations of EMS, so we were unable to test expanded memory on this board. (For more information on EMS emulation, see "Emulating Expanded Memory: Five Software Alternatives," *PC Magazine*, Volume 6 Number 6.) This emulation allows a portion of expanded memory to function as a RAMdisk. A command file can be called from your AUTOEXEC.BAT file to use a portion of the expanded RAM as a print spooler. The installation program is relatively straightforward, which is a good thing, since there is no description of it in the manual.

■ The IDEASupermax/EMS implements EMS in its software. A command file can be called from your AUTOEXEC file to use the expanded RAM as a print spooler.

The other disk, IDEAmenu, contains an assortment of utilities for using the board in extended-memory mode. Stepped through by way of too many menus (hence the name), the configuration program allows the creation of a RAMdisk (only one, and it's limited to 640K bytes) and a print spooler and setting the clock.

The utilities menus (two of them) have access programs that perform functions such as program timing, file concatenation, word count, changing file attributes, copying hidden files, and an excruciatingly difficult reverse Polish notation (RPN) calculator. The diagnostics menu calls up programs to test the board's memory and the serial and parallel ports.

The documentation supplied with the IDEASupermax/EMS, while well organized and attractively printed, doesn't really tell you much about the information on the disks. The bulk of it is primarily printed screen images. Such a well-made board deserves better.

The IDEASupermax/EMS board is a fine product despite the inadequate manual. Not many of us refer to the manual once a board like this is installed in our system anyway.

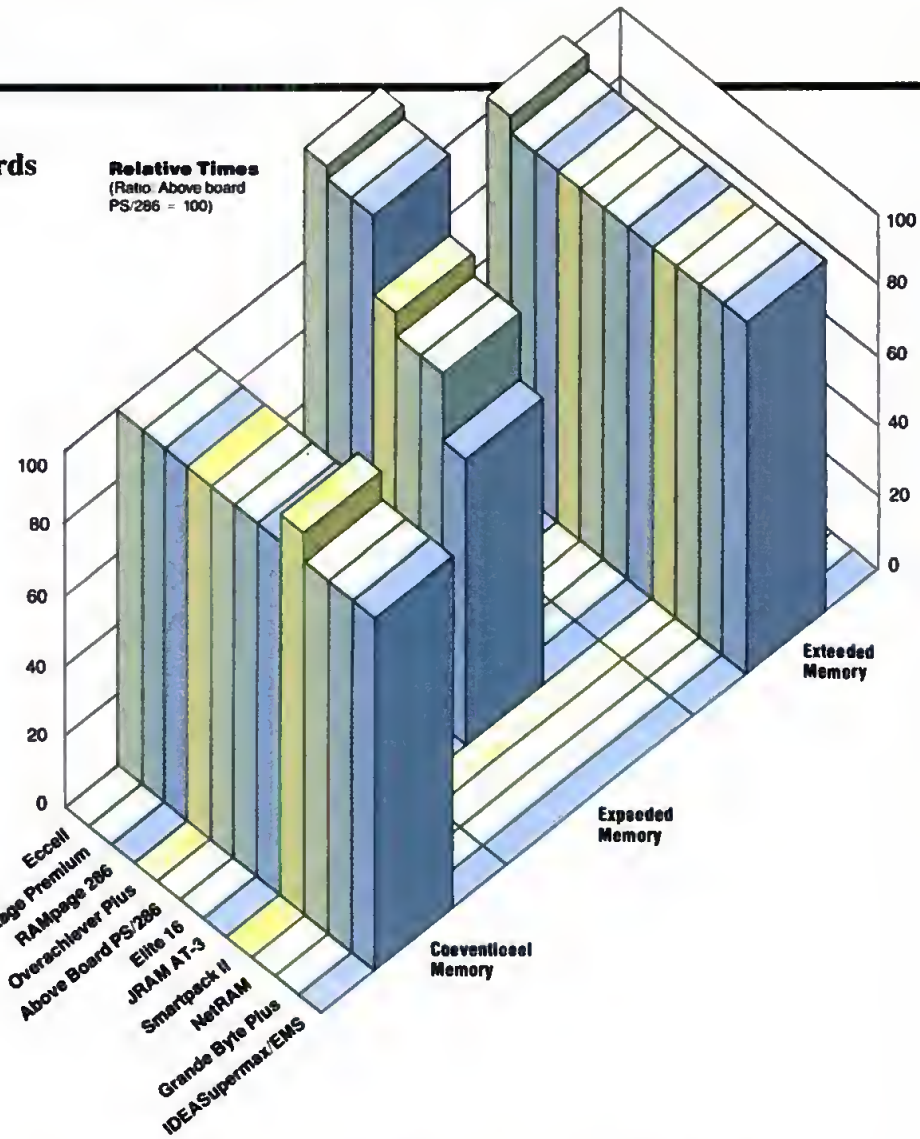
PC MAGAZINE FACT FILE

IDEASupermax/EMS
IDEAssociates Inc.
29 Dunham Rd.
Billerica, MA 01821
(617) 663-6878
List Price: With no memory, $475; with 512K RAM, $575; with 1.5 Mbytes, $975; 2.5-Mbyte daughterboard sold with 1.5-Mbyte board, $2,145.
Requires: AT-size 16-bit slot.
In Short: A very well-made multifunction board offering EMS memory and a decent complement of software to support it. Rather mediocre documentation is the only fly in the ointment.

CIRCLE 681 ON READER SERVICE CARD

Benchmark Tests: AT Multifunction Boards

The test results for all multifunction boards were very close for reading from and writing to conventional and extended memory. However, sound hardware design and efficient EMS device driver software made Tall Tree Systems' JRAM AT-3 approximately 20 percent faster than its nearest competitor in reading from and writing to Lotus/Intel/Microsoft expanded memory specification (EMS) implementations. IDEAssociates IDEASupermax/EMS implements EMS in software rather than hardware. PC Labs test results are shown only for hardware implementations. American Micronics' Smartpack II, Pure Data's NetRAM, and STB Systems' Grande Byte Plus did not include EMS drivers.



Performance Times
(Times given in seconds)

	Coevestioeal Memory	Expeeded Memory	Exteeded Memory
Eccell	1.3	4.1	15.8
Advantage Premium	1.3	4.0	15.2
RAMpage 286	1.3	4.0	15.2
Overachiever Plus	1.3	3.3	15 2
Above Board PS/286	1.3	3.1	15.2
Elite 16	1.3	3.1	15.2
JRAM AT-3	1.3	2.5	15.2
Smartpack II	1 4	N/A*	15.1
NetRAM	1.3	N/A*	15.1
Grande Byte Plus	1.3	N/A*	15.1
IDEASupermax/EMS	1.3	N/A†	15.2

The **Conventional Memory** benchmark test allocates 256K bytes of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **Expanded Memory** benchmark test allocates 256K bytes of expanded memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **Extended Memory** benchmark test allocates 256K bytes of extended memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

N/A*—Not applicable: does not include EMS driver.
N/A†—Not applicable: EMS implemented only in software; benchmark tests were run only on hardware.

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- Starflight *(reqs. CGA)* ..... 32.
- Chessmaster 2000 *(CP, reqs. CGA)* ..... 32.

Hayden Software ... CP
- Sargon III *(Chess program)* ..... 32.

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"BACK UP! BACK UP!" goes the battle cry. But if you have 30 or 40 megabytes of data out there, backing up to e floppy can be painfully slow. The new Mountain Tape systems can make that operation almost a joy.

- DC2000 cartridge system operates through the existing AT/XT286 drive controller under QIC-40 standard. Unit mounts internally for optimal space efficiency
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For the IBM AT & XT286 ..... $379.
Internel version also available for IBM PC & XT, and external versions available for IBM PC, XT, AT & XT286

Infocom ... NCP
- Bureaucracy Hollywood Hijinx
- Enchanter Hitchhiker's Guide
- Leather Goddesses of Phobos .... each 25.
- Zork Trilogy ..... 49.

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- Microleague Baseball *(reqs. CGA)* ..... 25.

Microprose ... CP
- F-15 Srike Eagle *(reqs. CGA)* ..... 22.
- Silent Service *(reqs. CGA)* ..... 22.

Microsoft ... CP
- ☐ Flight Simulator 2.13 *(reqs. graphics brd.)* 32.

Mindscape ... CP
- Balance of Power *(reqs. graphics brd.)* ... 30.

1Step Software ... CP *(reqs. CGA)*
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Parlor Software ... CP
- Bridge Parlor *(best Bridge simulation)* .... 49.

Sierra On-Line ... CP
- King's Quest III *(reqs. CGA)* ..... 33.

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- Star Trek/Promethean Prophecy ..... 27.

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- Orbiter *(Shuttle simulation, reqs. CGA)* .... $27.

Sublogic ... CP
- *Jet (reqs. graphics brd.)* ..... 33.

XOR ... NCP
- NFL Challenge ..... 79.

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- SixPakPremium 256k C/S/P *(upgrades to 1 Mb or 2 Mb w/Piggyback)* ... call
- Advantage Premium 512k S/P *(upgrades to 1 Mb or 2 Mb w/Piggyback)* ... call
- RAMpage! 256k *(upgrades to 2Mb)* ..... call
- RAMpage! 286 512k *(upgrades to 2Mb)* ... call
- Hot Shot 286 ..... call

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- Video 410A Amber monochrome monitor 169.
- Color 722 *(EGA compatible)* ..... 499.

Compucable ... lifetime
- Smartmodem-to-AT cable *(9 feet)* ..... 19.
- 15-foot Parallel Printer cable ..... 27.
- 2-Position *(AB switch box, 2 yr. warranty)* .... 39.
- 3-Position *(ABC switch box, 2 yr. warranty)* .. 65.

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- Universal System Stand ..... 25.

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- Printer-to-IBM cable *(9 feet)* ..... 17.

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- Diamond *(6 outlets)* ..... 29.
- Ruby *(6 outlets; EMI/RFI filtered; 6 ft cord)* ... 55.
- Ruby-Plus *(w/FAX & modem protection)* .... 65.

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- EX-1000 printer *(136 col., 300 cps)* ..... 539.
- FX-86e printer *(80 col., 200 cps)* ..... 349.
- FX-286e *(136 col., 200 cps)* ..... 479.
- LQ-800 printer *(80 col., 180 cps)* ..... 479.
- LQ-1000 printer *(136 col., 180 cps)* ..... 669.
- LQ-2500 printer *(136 col., 324 cps)* ..... 939.
- LX-800 printer *(80 col., 180 cps)* ..... 189.
- *Printer-to-IBM cable (6 feet)* ..... 15.

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Evercom II 2400 Internal Modem. . . . . 199.
5th Generation ... 6 months
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Hayes ... 2 years
Smartmodem 1200 . . . . . 299.
Smartmodem 1200B *(w/Smartcom II)* . . . . 299.
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P351 S/P printer Mod 2 *(136 col., 288 cps)* 939.
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EVA 480 *(supports 640x480 res., includes Dr. Halo II & drivers for Autocad & Lotus 1·2·3)* 349.
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For the IBM-PC (XT & AT) exclusively.

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INTEL CORP.

Above Board PS/286

Intel Corp.'s Above Board PS/286 has a heritage that places it at the root of the PC-family genealogy tree. After all, this is the company that designed the microprocessor in every MS-DOS machine made today, whether it's based on the 8088, 8086, 80186, 80286, or the most recent 80386 CPU. There's no reason to think that it wouldn't be compatible with an 80-whatever-86, should another one crop up in the future.

If this weren't enough, Intel was also instrumental in establishing the Lotus/Intel/Microsoft EMS. To say that compatibility isn't a consideration here would be an understatement of legendary proportion. The stripped-down Above Board lists for $745 with 512K bytes of memory and, with piggyback boards, can grow to 4 megabytes. Not surprisingly, Intel supplies a list of software known to operate with the Above Board's expanded memory, and all of the big-name software publishers are here—Lotus, Borland, Ashton-Tate, Javelin, Microsoft, Quarterdeck . . . you get the picture.

The main circuit board of the PS/286 has been thoughtfully sized to fit into the standard chassis of the IBM PC, XT, or PC-XT Model 286, as well as the AT. Not only that, it can be configured to function with either the 8-bit bus of the PC or original XT as well as the 16-bit bus found on the AT and XT 286. When installing the Above Board in a PC, you have to insert a jumper set into a 14-pin DIP socket. Other than that, there are no jumpers or DIP switches to contend with. All other configuration settings are handled by the software disk provided with the package.

Our test board came with 2 megabytes of 120-nanosecond 256K-bit RAM chips. An additional 2 megabytes of memory can be attached by way of several header connectors on the top edge of the board.

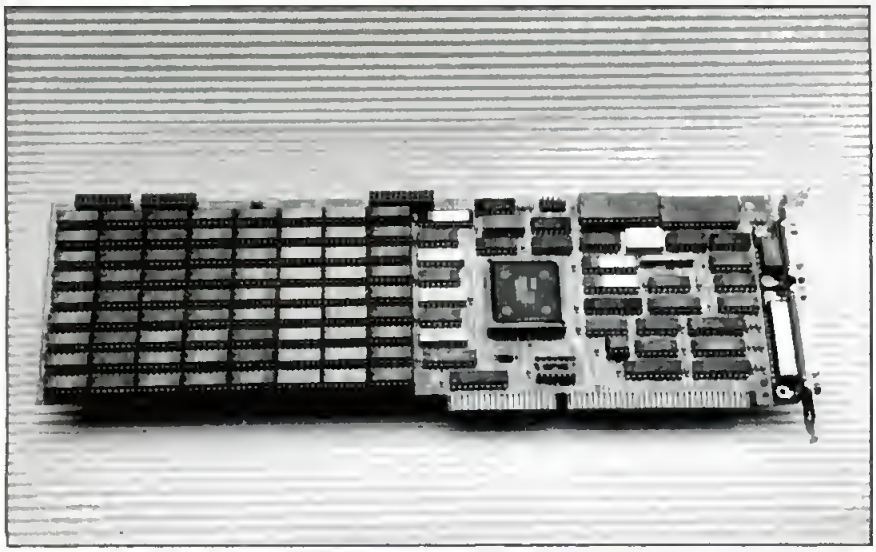
Memory can be set up three ways, depending on the requirements of your system. One chunk can be set aside to raise the conventional DOS memory from 256K or 512K bytes up to the DOS limit of 640K bytes. The remaining memory can be configured to conform to either the extended or the expanded memory modes. If you want to operate with a bit of each, go right ahead—it's simply a matter of telling the installation software how much of each type of memory you desire. The only limitation is that memory can only be allocated in 512K-byte blocks because of the 16-bit address bus.

Intel advertises that the Above Board PS/286 can run at speeds up to 12.5 MHz in 16-bit-bus systems and 8 MHz in 8-bit systems. With a full complement of 120-nanosecond RAM chips, it had no problem whatsoever running on an 8-MHz PC's Limited AT.

The documentation supplied with the Above Board PS/286 was certainly the best of the lot. Although many of its competitors have gone to loose pages in search of a proper binder, Intel has seen fit to supply properly bound manuals—two of them, in fact. The larger one is aimed at those who have no experience installing a board in their computer. It goes so far as to tell you which part numbers constitute acceptable memory chips for the board and how to install them. This saves a trip back to the dealer for an expansion job that virtually anyone with basic manual dexterity should be able to perform.

The second manual is billed as being for "DOS experts only," but don't believe it. If you have lived with an MS-DOS–based system for more than a couple of months, then you will probably be able to use it to copy the proper files to your boot disk and have your system operating in a matter of minutes.

Should you decide to go the beginner's route, you'll find the INSTALL program works easily and predictably. A series of repetitive screens asks you for the installation options you desire. At the termination of these, the appropriate device drivers (for expanded memory, print spooler, or RAMdisks) will be copied to the root di-



Intel's Above Board PS/286 can grow to 4 megabytes with piggyback boards. The main circuit board can fit into the standard chassis of the PC, XT, XT Model 286, and AT.

PC MAGAZINE FACT FILE

Above Board PS/286
Intel Corp.
Personal Computer Enhancement Operation
5200 NE Elam Young Pkwy.
Hillsboro, OR 97124
(800) 538-3373
List Price: With 512K RAM, $745; with 2 Mbytes, $1,195; optional serial port, $50; with 512K piggyback board, $495 additional; with 2-Mbyte piggyback board, $995 additional.
Requires: PC or XT 8-bit, or PC-XT Model 286 or AT 16-bit slot, or PS/2, Model 30.
In Short: A very fine expanded memory board that will function in everything from garden-variety PCs to high-speed AT compatibles. The documentation is by far the best of the lot.

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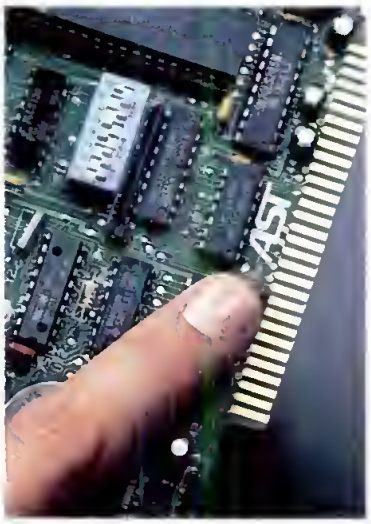

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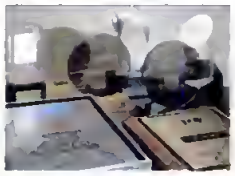

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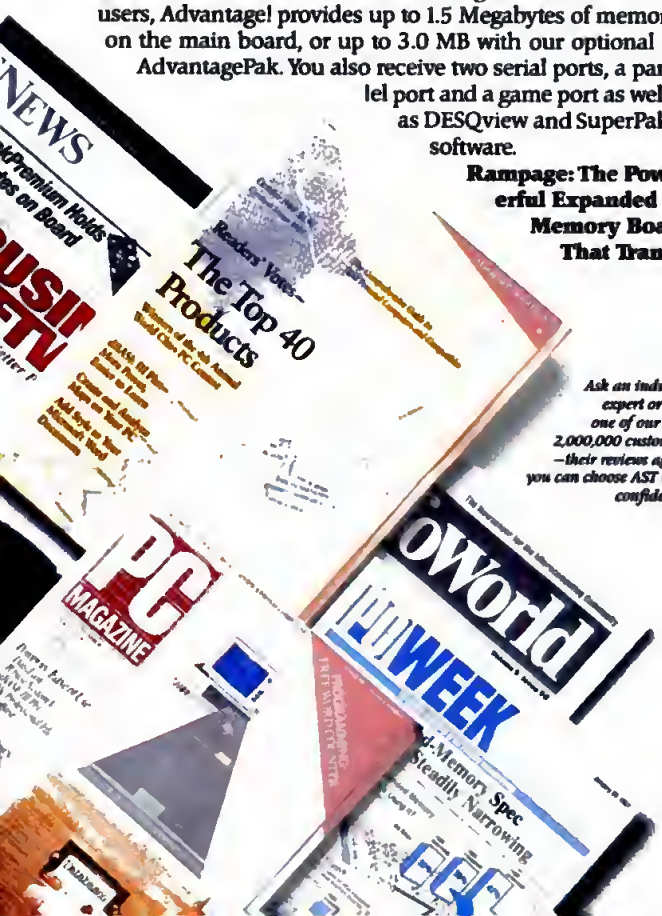

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How to keep up with

"This is a true multi-user database. When we saw the automatic screen up-dating, you could've scraped our jaws off the floor."

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"Paradox 2.0 will do for the LAN what the spreadsheet did for the PC."

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Glen Herbert
Software Developer

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concurrent events

"Record locking is incorporated into the interface so the user doesn't have to worry about it."

Harry Strauss
Microtec Planning

"The great thing is that it does more of the network thinking for you."

Michael Addice
Aveco Computer Services

Introducing Paradox 2.0. More power for single users, unparalleled power for multiple users.

New Paradox® 2.0 puts the power of the emerging relational database standard into everyone's hands. Single users and multiple users. Now everyone you work with can share information in a way that no other multiuser PC database can offer.

For single users, Paradox 2.0 improves the standard that Paradox 1.1 set for ease of use, speed and power.

For multiple users, Paradox 2.0 offers that same performance plus the unequaled ability to edit, browse, query, sort and report a file concurrently—to get information in real time.

Same time, same network

The multiuser capabilities of Paradox work like an airline reservation system, where people share and update information constantly. Without getting in one another's way. This transparent, concurrent data sharing lets users do things that are impossible in other PC databases.

For example, other databases often lock entire files, or else lock records in a way that makes the data below inaccessible.

Paradox 2.0, on the other hand, lets users edit, browse, query, sort and create reports in the same file at the same time. Records lock automatically, telling others the user's name, and leaving data below accessible. When revisions are made, the changes appear on all screens in real time. Or at a set interval. With all these features, Paradox helps more people get more done.

This performance comes without the noticeable speed loss that plagues most multiuser databases. But advanced multiuser capabilities are just some of the enhancements in Paradox 2.0.

Expanded coverage

Paradox has kept its familiar Lotus®-like interface and artificial intelligence to simplify operation and hide complexity from the user. On top of this, we've added more performance for single users, new users and developers.

Our intuitive "query by example" now has a "Zoom" command that pinpoints data faster. Paradox 2.0 supports up to two billion records along with EMS and EEMS to speed processing of your largest applications.

Reports have new features like word wrap and multicolumn mailing labels. And thinking ahead, we offer both 3½- and 5¼-inch diskette formats.

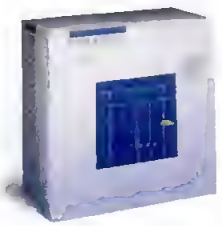
For new applications, Paradox 2.0 is also a more powerful tool, with 48 new Paradox Application Language commands and functions, sample programs, a data entry toolkit and other helps—many to speed multiuser application development.

Eyewitness report

Study these current events and it's not surprising that American Airlines, First Boston, Mass Mutual and hundreds of other top companies are standardizing on Paradox. Not for one reason, but for many.

To get the firsthand story, call 1-800-447-4700, Department 254. Just ask for information and the location of your nearest Ansa dealer, who can give you a free Paradox 2.0 demonstration diskette. In the U.K., call 01-580-4766.

PARADOX
by Ansa



CIRCLE 125 ON READER SERVICE CARD

rectory of your boot disk, and the CONFIG.SYS file will be modified to start these on power-up. Additional programs are supplied to test the added memory and to alter the extended/expanded memory configuration for your system.

The Above Board PS/286 is a well-designed board that promises to broaden the horizons of your PC/XT/AT (and probably their replacements) for quite a while. The excellent documentation and software serve to reinforce Intel's position as a leader in PC technology.

ORCHID TECHNOLOGY INC.

Eccell

Orchid Technology has long been a leader in high-performance additions to computers in the PC family. Its accelerator boards have given new life to a great many PCs facing eventual obsolescence.

The firm's Eccell AT multifunction board, which with 512K bytes of memory lists at $745, lives up to this commitment to blistering performance. The combination of hardware and software not only expands the memory reaches of the AT into the realm of the minicomputer, but it can greatly enhance the operation of the system's hard disk as well.

The most important feature of the Eccell may be its automatic error correction for the board's RAM chips. The parity check protocol used by all of the other boards in this review (and on the AT's system board as well) will halt the system with a "PARITY CHECK 2" error message, but all of the data contained in RAM will be lost. With error correction code (ECC), not only will individual data-bit errors be corrected, but an entire RAM chip can be disabled within each 512K-byte memory bank without affecting operation.

ECC was dramatically (and unintentionally) demonstrated during our benchmark tests. The board was installed in an AT-compatible system and handled the programs without a hitch. We later discovered that one of the RAM chips had been improperly installed, with three of the IC legs bent under. ECC compensated for the bad chip with no indication that anything was wrong. With more and more people buying memory boards to run ever-larger spreadsheets, it's reassuring to know that the memory system won't give up at the worst moment.

The only real penalty for this protection is the number of RAM chips needed for each memory bank. Although the usual parity-checked system requires 9 chips for each 256K-byte bank, Orchid's ECC requires 11.

The Eccell is actually composed of three boards—a motherboard holding 1 megabyte of memory, one daughterboard that contains an additional 2 megabytes of RAM, and a second, smaller card that services the serial and parallel ports. This last one can be replaced by a dual–serial port unit if that's what you need.

Conspicuously absent are the conventional set-up DIP switches. A few jumper straps are used on the I/O card, but otherwise all of the configuration settings are done by software controls.

One real curiosity on the Eccell board is a 48-pin circuit that apparently had any markings removed from its surface with sandpaper (yes, sandpaper). The only information I was able to pry out of Orchid about this was that it was part of the error correction circuitry.

ECC alone would be enough to make the Eccell a desirable multifunction board, but Orchid didn't quit there. Orchid has also seen fit to endow the board with a number of useful software delights, such as a print spooler, RAMdisk emulator, and an EMS device driver.

Most fascinating of all was the performance of the disk cache software. Caching speeds up disk drive access by putting a data file in RAM where it can be accessed quickly. The acid test was the PC Labs File Access benchmark test. Caching reduced both sequential and random-access file read times by approximately 80 percent. The time required to write to a disk file was, as expected, about the same whether the cache driver was used or not.

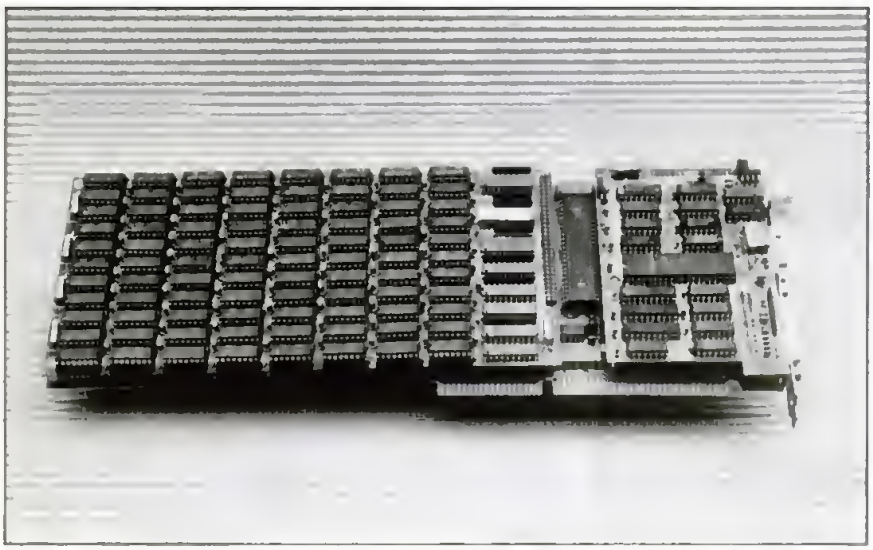
The RAMdisk emulator means that

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Eccell
Orchid Technology Inc.
45365 Northport Loop West
Fremont, CA 94538
(415) 683-0300
List Price: With no memory, $595; with 512K RAM, $745; with 1 Mbyte, $895; 2-Mbyte RAM daughterboard sold with 1-Mbyte Eccell, $1,495.
Requires: AT 16-bit slot.
In Short: Automatic error-correcting code makes Eccell a winner for memory-conscious buyers. The disk cache software will boost disk-access intensive software to new performance levels.

CIRCLE **679** ON READER SERVICE CARD



Orchid Technology's Eccell AT multifunction board, with 512K, can use hardware and software combinations to expand an AT's memory reach to 16 megabytes.

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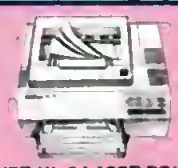

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data stored in RAMdisk memory is not lost during a Ctrl-Alt-Del warm boot. As with all RAMdisks, though, remember to save your data on the real thing before switching the computer off.

Eccell's ECC circuitry alone might be worth the price of admission to the Orchid clan if your needs demand more than parity-checked RAM. The excellent support software makes it just that much better.

PROFIT SYSTEMS INC.

Elite 16

Just imagine loading your AT up with as much memory as a VAX 11/750 minicomputer—16 megabytes, to be exact (all that the 80286 CPU can handle). Not long ago, the only way to put that much into a PC-sized computer would have been to open the top and dump it in with a shovel. Amazingly, Profit Systems' Elite 16 manages to squeeze that ability onto a single board, with enough space left over for three I/O ports. The standard Elite 16 board comes with 512K bytes of RAM and lists for $695. It can be expanded, megabyte by megabyte, up to 16 megabytes. Or you can buy the board with the full 16 megabytes at a list price of $4,945.

As you might guess, this high-density packing wouldn't be possible with yesterday's technology. The Elite 16's high-quality multilayer board combines the use of surface-mounted devices (SMDs) along with a number of conventional ICs. Furthermore, the use of SMDs allows components to be mounted on both sides of the board.

The memory itself is also state of the art, in the form of single inline memory modules (SIMMs). Each SIMM consists of a small (½- by 3-inch) board holding nine SMD RAM chips. These chips attach by an edge connection to 30-pin inline sockets on the main board. Up to 16 SIMMs can be plugged in, and both 256K-byte and 1-megabyte versions are available. On the downside, SIMMs are still relatively expensive compared with conventional RAM chips.

This high-technology design also allows the board to operate in Compaq's Deskpro 386 as well as 12-MHz AT compatibles. In AT-class systems running at 6 or 8 MHz, the board runs with zero wait states, and it did run the PC Labs Expanded Memory read/write benchmark test faster than most others. It's also small enough to comfortably fit into IBM's PC-XT Model 286.

A parallel port and one serial port come as standard equipment, with a second serial port optional.

Conspicuous by their absence are the usual arrays of configuration DIP switches and jumpers—not a single one can be found anywhere. In fact, the only hardware control is a single rotary switch that sets the starting address in the unlikely event that more than one memory board is installed in the computer.

All of this wizardry is not performed with mirrors, but rather with the easiest-to-use installation software of any board tested. Profit Systems calls the program *AutoRAM*, and the name couldn't be more appropriate. Install the board, pop the disk into drive A:, run the program, and you're done. *AutoRAM* automatically determines the amount of conventional and expanded memory already installed in the system and the amount and type of SIMM memory on the Elite 16 and installs a device driver on the boot disk. The only thing that remains is to modify the CONFIG.SYS file to include the statement DEVICE = AUTORAM.SYS as its first entry. The only way it could be made any easier would be for it to modify CONFIG.SYS for you.

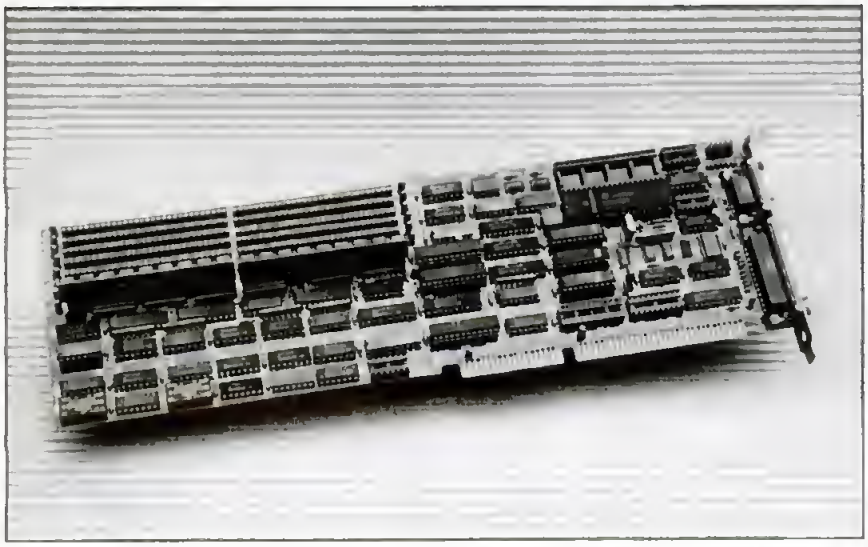
If left to its own devices, *AutoRAM* configures the first 640K bytes of memory to conventional DOS memory, the next 8 megabytes to EMS, and any remaining memory to extended memory. If this arrangement doesn't meet your needs, you can direct *AutoRAM* to set up memory allocation as you require.

A memory test is run during installation, and any bad SIMMs are automatically locked out. Your PC will still function normally (with less RAM) until you can replace the defective SIMM.

PC MAGAZINE FACT FILE

Elite 16
Profit Systems Inc.
30150 Telegraph Rd., #173
Birmingham, MI 48010
(313) 647-5010
List Price: With 512K memory, $695; additional 512K RAM sold as two 256K chips, $250; additional 2 Mbytes, $1,000 for two 1-Mbyte modules; with 16 Mbytes, $4,945.
Requires: PC-XT Model 286 or AT 16-bit slot.
In Short: Sixteen-megabyte, single-board capacity along with three I/O ports make the Elite 16 the favorite choice for those with limited expansion slots.

CIRCLE 678 ON READER SERVICE CARD

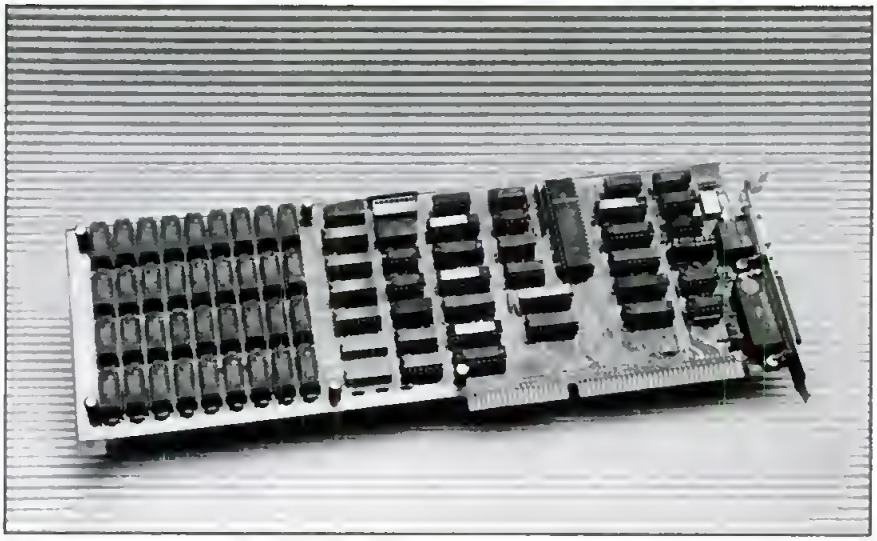


Profit System's Elite 16 can load an AT with as much memory as its 80286 CPU can handle—16 megabytes. It also has three I/O ports.

AutoRAM's device driver supports both the EMS and EEMS arrangements. Of course, the entire board can be allocated to extended RAM for those running under Xenix.

The documentation supplied with the Elite 16 might seem a bit skimpy, but that's because it doesn't have to do much. The software takes care of those parts of the installation process (like DIP switch settings) that constitute a major part of most other manuals. What little you do need to refer to is all there and very easy to understand.

Profit Systems has thankfully given the Elite 16 just about everything you could think to ask for in a memory board (including the potential to hold all of the memory your 80286 machine can digest). Best of all, it's combined with the simplest installation software extant. The only way Profit Systems could possibly improve the package would be to throw in a decent enhancement program for the operating system to allow concurrent operation of MS-DOS programs.



Pure Data's NetRAM uses the full design height of the AT chassis. All of its integrated circuits are mounted by means of DIP sockets.

PURE DATA LTD.

NetRAM

If you got your start in computing on the venerable Apple II Plus, then you'll be immediately at home with Pure Data's NetRAM multifunction board. Way back in 1979, manufacturers had a habit of mounting just about every integrated circuit in sockets, and with good reason. Those old boards had a habit of sending most any IC up in a puff of smoke when you least expected it.

Pure Data apparently has less faith in current IC construction than most of its competitors, because all of the ICs on the company's NetRAM board are mounted by means of DIP sockets. This could no doubt save you a trip to the repair shop should one of the ICs give up the ghost.

Except for the abundant sockets, the construction of the NetRAM is rather typical for boards of this type. A pair of wire jumpers on the bottom side of the board (along with cut tracings on the top) probably haunt some poor circuit board engineer more than they will the NetRAM owner.

The NetRAM circuit board uses the full design height of the AT chassis, but I couldn't help wondering why. The component count is certainly low enough that it could have been easily sized to fit into the PC-XT Model 286 chassis as well.

An interesting dichotomy of purpose is the board's use of the high-speed 16450 UART chips controlling the serial port and the rather slow 150-nanosecond 256K-bit memory chips. Although the serial port can be counted on to function in just about any AT clone, the RAM chips would seem to preclude use in systems running at speeds above 8 MHz.

The maximum memory configuration of the NetRAM is a rather paltry 1.152 megabytes, which lists for $699 installed. No provision is made for attaching a daughtercard with additional RAM chips. A separate 128K-byte bank of memory serves to fill the standard AT's 512K-byte configuration up to the full 640K-byte DOS memory limit.

A bank of nine jumpers is used to set up the configuration of the serial port. When they are set all to one side, the port operates in data communication equipment mode (DCE, used by most modems). When they are all moved to their other position, the serial port functions in data terminal equipment mode (DTE, the protocol most frequently seen on serial printers). The jumpers can also be moved individually to accommodate nonstandard device requirements.

The documentation supplied with the NetRAM was above average. It makes no assumptions about your knowledge of the AT. You'll be further helped by a number of well-drawn diagrams and charts that not only show you how to configure and install the board, but also explain the way the board interacts with the AT and its peripherals. The section on the serial port is particularly helpful, giving cabling examples for various devices.

All things considered, there is really nothing to complain about with the NetRAM—it performs as advertised and real-

PC MAGAZINE FACT FILE

NetRAM
Pure Data Ltd.
860 Denison St., #12
Markham, Ontario
Canada L3R 4H1
(416) 475-3370
List Price: With 128K memory installed, $499; with 1.152 Mbytes installed, $699.
Requires: AT-size 16-bit slot.
In Short: A "generic" AT multifunction board. It does everything it has to, but provides none of the extras found with most of the other packages.

CIRCLE 677 ON READER SERVICE CARD

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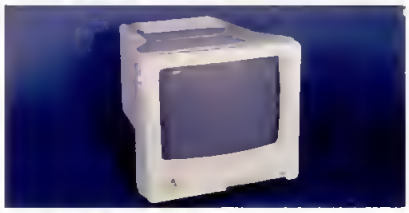

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CIRCLE 183 ON READER SERVICE CARD

ly has no untoward vices. The "generic" label has been attached to everything from prescription drugs to beer; the NetRAM would also qualify, should the same connotation be applied to multifunction boards. On the negative side, Pure Data should really consider bundling it with some useful utility software. Cleaning out your wallet for a multifunction board is a major proposition, and it's a shame to have to dig even deeper to purchase software to put it to use.

STB SYSTEMS INC.

Grande Byte Plus

The Grande Byte Plus package, from STB Systems, falls right in at midpack in this series of reviews. Neither outstanding nor pathetic, it offers a number of features that might just fill the bill in your quest for more memory in your AT, the most noteworthy of which is semivolatile RAMdisk software.

For openers, the board offers the ability to back-fill the void left between an IBM PC AT's maximum 512K bytes of installed main-board memory and the MS-DOS limit of 640K. From here, additional memory on the board can be expanded up to 2.5 megabytes at a list price of $1,495. This additional memory can be installed to operate only as conventional extended memory (suitable for RAMdisks, print spoolers, or an operating system such as Xenix), not as expanded memory conforming to the Lotus/Intel/Microsoft specification.

The dual-layer board appears to be of generally high quality, and the entire 2.5 megabytes will fit on the main board—no provision is made for attaching a daughterboard. Since it utilizes the full height designed for the AT, you can forget trying to place this one in the PC-XT Model 286.

The serial port is controlled by an 8250 UART chip, so the Grande Byte Plus just might have a problem when used in AT compatibles running at speeds higher than 8 MHz.

Sixteen DIP switches and three jumpers are used to configure the board for your particular installation, and you're likely to become intimately familiar with them. These are used to conform to the base memory installed on the computer's motherboard, the amount of memory on the STB board itself, and both parallel and serial port logical designations.

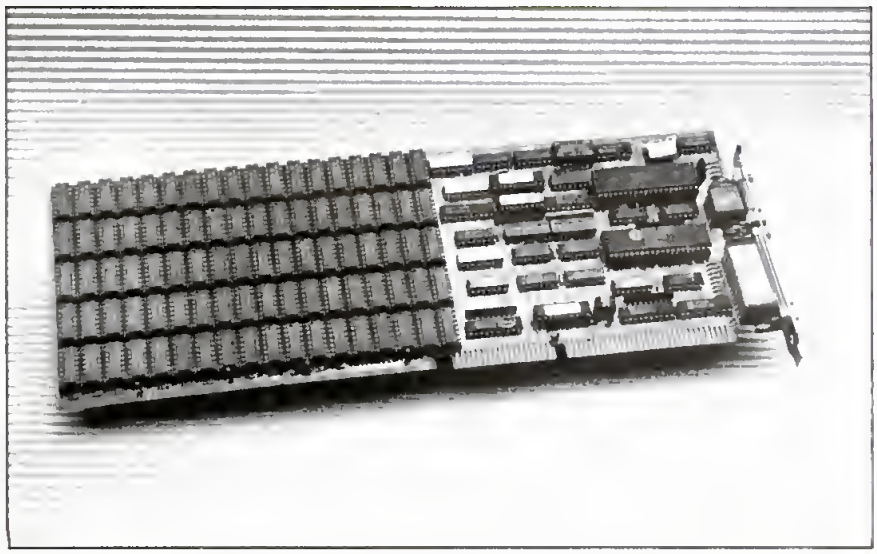
To install the Grande Byte Plus, you'll need the SETUP program on the IBM PC AT diagnostics disk (a few of the AT clones offer this program within their ROM circuitry), because the first message encountered after installing the board will be "164—memory size error." No problem, really—just run the program and tell the system how much memory is allocated to DOS and how much you have in the expanded area.

You're likely to find a bit of difficulty with the manual's DIP switch configuration charts. There are a bunch of them, and the information needed to configure the DIP switches may be beyond novice AT users. You might want to enlist the help of a benevolent hacker (more than a few high school students fill the bill) to help out.

STB's trump card lies in the software supplied with the package. The *PC Accelerator* (*PCA*) disk contains a number of programs, the most useful of which has got to be the RAMdisk emulator. Up to ten RAMdisks can be configured in the extended memory area, and they behave just like their physical counterparts, only much faster. Unlike most other RAMdisks, those installed with the *PCA* software can survive a Ctrl-Alt-Del warm boot without losing any information. Of course, everything will be lost if the power is turned off.

Up to three printer buffers can be set up in extended memory, and a utility program allows you to swap the printer's port assignment (LPT1, LPT2, or LPT3) electronically as opposed to physically moving the cables on the back of the computer.

A *PCA* installation option allows you to add password protection to the AT's hard disk. On startup, the correct password must be entered in order for the boot process to continue. Entering the wrong password will cause the computer to go into a coma. Unfortunately, this protection



STB Systems' Grande Byte Plus can back-fill the void left between an IBM PC/AT's maximum 512K bytes of installed mainboard RAM and the MS-DOS limit of 640K.

PC MAGAZINE FACT FILE

Grande Byte Plus
STB Systems Inc.
P.O. Box 850957
Richardson, TX 75085
(214) 234-8750
List Price: With no memory, $319; with 512K RAM, $579; with 1 Mbyte, $745; with 2.5 Mbytes, $1,495.
Requires: AT-size 16-bit slot.
In Short: A middle-of-the-road 2.5-Mbyte expanded memory multifunction board for AT owners only. Better-than-average software makes it worthy of consideration.
CIRCLE 676 ON READER SERVICE CARD

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■ STB's *PCA* installation option allows you to add password protection to the AT's hard disk.

scheme can be circumvented simply by booting the computer from a DOS system disk.

STB's Grande Byte Plus and the *PC Accelerator* software add up to a splendid package for those who require only extended memory in their AT.

TALL TREE SYSTEMS

JRAM AT-3

Quick memory access is what distinguishes Tall Tree Systems' JRAM AT-3 from the rest of the boards in this review. Through sound hardware design and efficient EMS device driver software, this multifunction board ripped through the PC Labs benchmark test software faster than any other tested. Both reading and writing to the Lotus/Intel/Microsoft EMS were approximately 20 percent faster than the nearest competitor.

This doesn't necessarily imply that the JRAM AT-3 would be the first choice for one of the hyperthyroid AT clones with their 12-MHz clock rates. The 2 megabytes of socketed RAM chips on the main board are rated for 150-microsecond operation, and while they performed flawlessly on the test 8-MHz system, they would probably falter on one of the faster systems. Controlled by an 8250 UART chip, the serial port would also have problems at higher speeds. The manual, in fact, states that the board is not guaranteed to work faster than 8 MHz with one wait state.

Construction of the JRAM AT-3 is a bit different from all the rest in that, where most manufacturers put the I/O port hardware on the main board with a daughtercard containing at least some of the memory, the JRAM AT-3 has up to 2 megabytes of RAM chips on the main board, and a smaller add-on board handles the serial and parallel port chores. Construction of both boards appears to be of very good quality, and all of the RAM chips are socketed for easy replacement. Too tall to fit in an IBM PC-XT Model 286, it can only be used in an AT or compatible.

Hardware configuration comes in the form of 16 DIP switches and 12 jumpers. The reason that there are so many jumpers is that the serial/parallel module is used on a number of other Tall Tree boards as well as this one.

One very thoughtful inclusion with the JRAM AT-3 is a 4-foot-long modem cable. Most board makers leave you to your own devices in conjuring up a cable from the AT-style DB-9 connector to your modem's DB-25 connector. No big deal, really, but appreciated nevertheless.

The documentation supplied is well prepared and complete, though not the thing for people whose knowledge of the computer is limited to turning it on and running their word processor. It's quite a bit more technically oriented than most, and it assumes that you have a fair understanding of the hardware under the AT's hood.

The JRAM software disk contains the drivers for the EMS, print spooler, and RAMdisk emulator. These are written to the boot disk's root directory with the DOS COPY command, and you'll have to edit the CONFIG.SYS file for them to execute on start-up. Several other packages make this an almost automatic task. A README file contains updated information about the contents of the disk.

There are quite a number of device drivers on the disk; they can be used to tailor the JRAM AT-3 to your needs. Drivers are supplied to establish a portion of the board's memory for EMS operation, to set aside a portion of RAM as a print spooler, and for the creation of RAMdisks in both extended and expanded memory. The assembly language source code files for a number of these are supplied, just in case

PC MAGAZINE FACT FILE

JRAM AT-3
Tall Tree Systems
2585 E. Bayshore Rd.
Palo Alto, CA 94303
(415) 964-1980
List Price: With no memory, $349; with 512K RAM, $439; with 1 Mbyte, $529; with 2 Mbytes, $709.
Requires: AT-size 16-bit slot.
In Short: EMS memory access speed sets the JRAM AT-3 above the rest. Amenities include assembly-language source code for the software and a modem cable.
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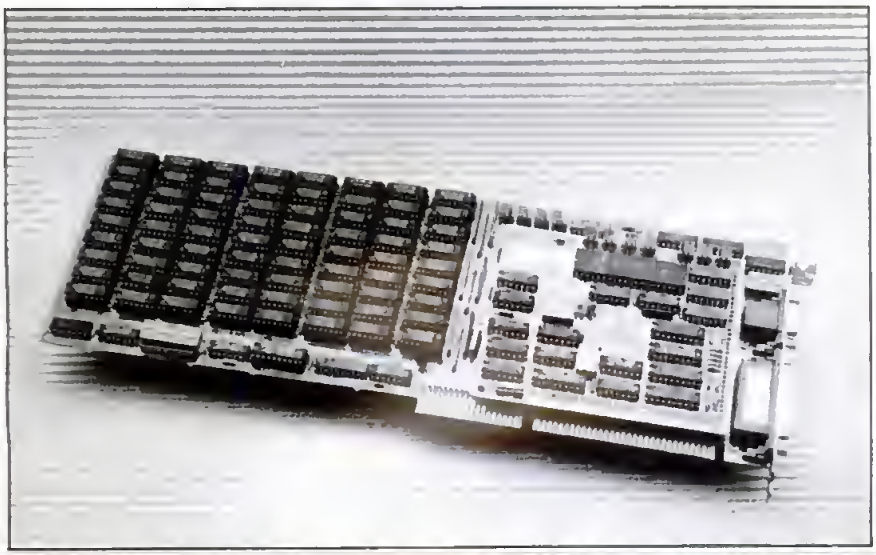

Tall Tree Systems' JRAM AT-3 has a quick memory access feature that reads and writes to EMS at least 20 percent faster than other boards in this review.

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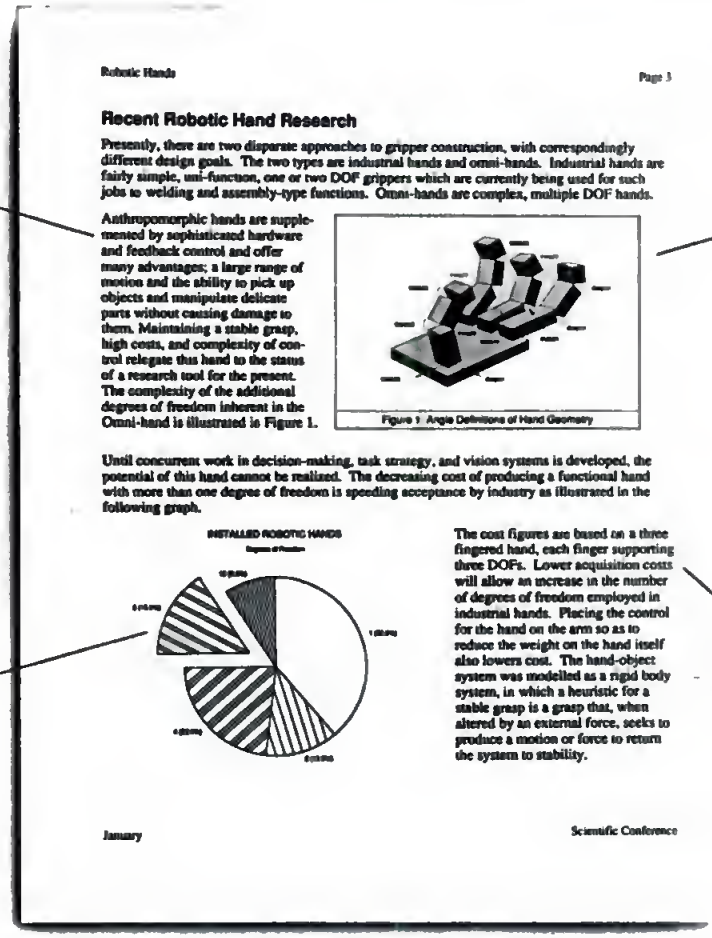

Robotic Hands — Page 3

Recent Robotic Hand Research

Presently, there are two disparate approaches to gripper construction, with correspondingly different design goals. The two types are industrial hands and omni-hands. Industrial hands are fairly simple, uni-function, one or two DOF grippers which are currently being used for such jobs as welding and assembly-type functions. Omni-hands are complex, multiple DOF hands.

Anthropomorphic hands are supplemented by sophisticated hardware and feedback control and offer many advantages; a large range of motion and the ability to pick up objects and manipulate delicate parts without causing damage to them. Maintaining a stable grasp, high costs, and complexity of control relegate this hand to the status of a research tool for the present. The complexity of the additional degrees of freedom inherent in the Omni-hand is illustrated in Figure 1.

Figure 1 Angle Definitions of Hand Geometry

Until concurrent work in decision-making, task strategy, and vision systems is developed, the potential of this hand cannot be realized. The decreasing cost of producing a functional hand with more than one degree of freedom is speeding acceptance by industry as illustrated in the following graph.

INSTALLED ROBOTIC HANDS

The cost figures are based on a three fingered hand, each finger supporting three DOFs. Lower acquisition costs will allow an increase in the number of degrees of freedom employed in industrial hands. Placing the control for the hand on the arm so as to reduce the weight on the hand itself also lowers cost. The hand-object system was modelled as a rigid body system, in which a heuristic for a stable grasp is a grasp that, when altered by an external force, seeks to produce a motion or force to return the system to stability.

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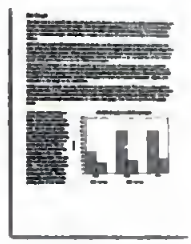

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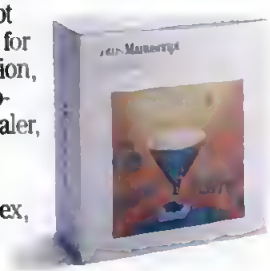

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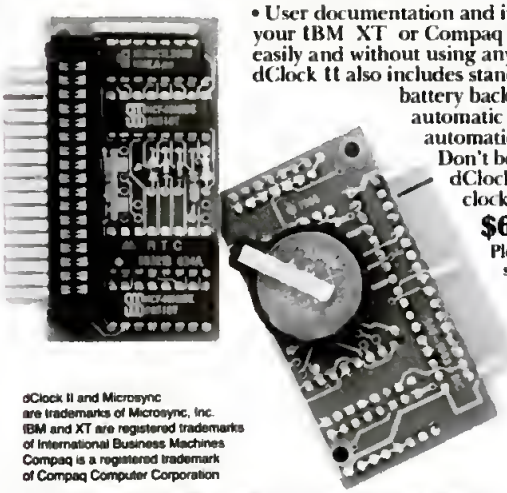

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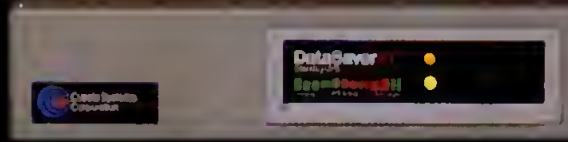

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■ MULTIFUNCTION BOARDS

PC MAGAZINE EDITOR'S CHOICE

- **Advantage Premium**
- **Eccell**

It's tough to come up with a clear-cut choice from this array of functionally similar multifunction boards. After all, they all do roughly the same things and at similar performance levels. In the final analysis, it's the excellent software and documentation that give AST Research's Advantage Premium a nod by the smallest of margins. The wise inclusion of Quarterdeck's DESQview *software package gives it the edge in usefulness.*

Orchid Technology's Eccell has the distinction of being the only board in the group to utilize a highly advanced memory error correction scheme. As desktop systems swell to minicomputer-sized memory configurations, this feature alone could prevent an otherwise-productive day from turning into a nightmare.

Honorable mention should be made of Profit Systems' Elite 16 for its advanced hardware technology, allowing 16 megabytes of memory to reside on a single board, and to Intel Corp.'s Above Board PS/286 for its ease of setup.

you want to try and figure out what they are really doing with your system.

Although the basic JRAM device driver runs a parity check on the expansion memory each time the computer is booted, a more detailed program is supplied that allows you to narrow the problem to an individual chip.

If your primary consideration is the fastest possible recalculation time on that overly large *1-2-3* spreadsheet, then this is the board for you. Just keep in mind that it might have a problem when used in ATs running at speeds above 8 MHz.

Frank Bican is a departmental computer resources supervisor at a Cleveland medical center.

Case History #60341

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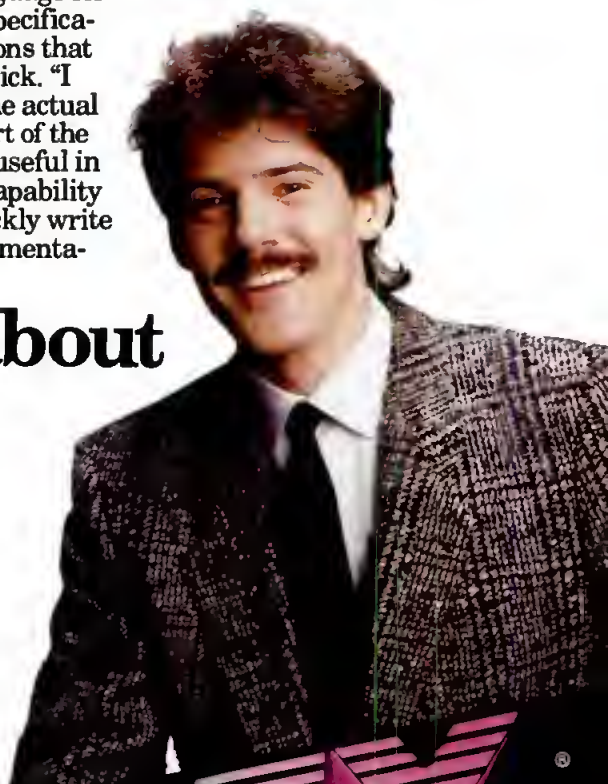

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CIRCLE 163 ON READER SERVICE CARD

NEC APC IVs:

COPYCAT ENGINEERING AT ITS BEST

NEC's new AT compatibles—the APC IV PowerMates 1 and 2—try to slice off their own share of IBM's sales with the traditional strategy of compatible makers: smaller size and faster processing. But their best weapon is likely to be quality engineering.

When sharpening the competitive edge for slicing into IBM's sales, makers of compatible computers generally rely on one of two strategies: building their machines smaller or making them faster. Taking advantage of both tactics, the new APC (Advanced Personal Computer) IV PowerMates 1 and 2 from NEC Information Systems assault IBM with a double-edged challenge.

Unfortunately, compact size and brisk microprocessing are not virtues of both PowerMate products. The PowerMate 1, almost a midget by IBM PC AT standards, has a footprint of 6½ by 16½ by 16½ inches (HWD), or about 5 inches smaller than an IBM PC AT, but it runs only as fast as the 8-MHz IBM AT prototype. The PowerMate 2 can sprint at a 10-MHz rate, but its AT-size frame does nothing to free up your desk space. These two machines are direct descendents of and replacements for the NEC APC IV, which was reviewed in "Competing at the Top: High-Performance ATs," *PC Magazine*, Volume 6 Number 2.

With prices that rate, at best, average in the highly competitive AT clone market—$1,845 for the PowerMate 1, $2,445 for the PowerMate 2—the new NEC computers have little allure other than the name and reputation of their manufacturer and their quality construction. (A NEC spokesman says that NEC is still analyzing what effect the U.S. tariff will have on Japanese computers and other electronics products. He also noted that NEC plans to strengthen its policy of building products in the country in which they will be sold.) As for innovation, the NEC engineers seem to be suffering from electronic echolalia, their designs being little more than rote repetition of what others have done.

The NEC name does have a lot of pow-

er behind it: known in nearly every field of electronics, the $13 billion company proclaims itself number one worldwide in semiconductors and number three in personal computers. With but one exception, however, names are hardly a selling point in the American PC marketplace today—and that exception uses initials quite different from NEC.

Thus the only hope the PowerMates have for acquiring a share of the PC market depends on high quality. NEC has nothing to be ashamed of with this equipment. Both PowerMates are well designed and well built, and they're among the quietest compatibles around. Although they don't stand out from any of the other unabashed AT clones on the market, they will easily earn their keep. That alone may be enough to make them successful. Then again, it has to be.

JAPANESE TWINS The two PowerMates are truly a pair—almost fraternal twins. They share many of the same design touches and much of the same technology, all of which is crafted in Japan.

Both are styled as squared-off boxes in a pale gray beige with just a touch more brown than in the standard IBM paint job. The front panels are mostly matching plastic, with their separate functional areas outlined by 8-inch-wide sculpted valleys. At front left, both systems have inset gray indicator panels with power and drive activity indicators.

Of course, each PowerMate has its own individual variations. The front panel of the PowerMate 1 is essentially flat, while the PowerMate 2's lower edge is tucked in about half an inch to make the machine look somewhat less massive. The PowerMate 2 also adds a system keylock (which also doubles as a reset switch) and a speed indicator LED.

The PowerMate 1 can house up to three drive units: two horizontal 5¼-inch half-heights and a 3½-inch drive mounted on its edge. The PowerMate 2 has room on its front panel for four of the wider drives. And there's space for an additional half-height 5¼-inch bay tucked out of sight under the right-hand stack of two.

Although attractive, the removable front panels of the PowerMates add an extra obstacle to the do-it-yourselfer who wants to expand his PowerMate with a more powerful disk drive. Before you can install a drive, you must remove the front panel by extracting two Phillips screws in the rear and releasing two plastic tabs—an additional, though not arduous, step.

Although the system boards of the two PowerMates differ in design details, both are built on the same electrical foundation: the Chips and Technologies AT integrated circuit set. The faster PowerMate 2 uses premium 10-MHz parts.

■ Both PowerMates are well designed and well built and will easily earn their keep. That alone may be enough to make them successful.

The PowerMate 1 matches the performance of the standard 8-MHz AT exactly, which is understandable considering that both the IBM and NEC machines use the same microprocessor—an 80286—operating at the same speed with the same number of wait states (one). Of course, the PowerMate 1 has a vacant socket where you can slide in an 80287 numeric coprocessor. NEC does not specify the operating speed of this chip, nor the speed rating required.

The PowerMate 2 pushes the speed limit up by 2 MHz (but doesn't cut the wait states) to deliver a 20 to 30 percent performance improvement over a top-of-the-line IBM PC AT. It, too, prepares a pad for an 80287 but does not specify its operating speed.

The operating speed of the PowerMate 2 is software selectable: either 8 or 10 MHz. The chosen speed is stored in CMOS memory, so the machine remembers its speed setting even after it's shut down.

The standard operating system shipped with both machines (at least the review units) is MS-DOS 3.2. NEC also included GW-BASIC 3.2 and a disk of diagnostics with each system.

Among AT compatibles, the PowerMates are unusual in that both come with the standard 640K RAM, the full DOS complement—but no more. Most of today's system designers opt for a full megabyte, giving you a little extra to use as a RAM-based disk emulator or, with the proper device driver, as EMS memory.

Because neither of the PowerMates reserves vacant sockets for onboard RAM, you must use separate boards to expand system memory. In the NEC scheme of things, this memory must be added in increments of 512K, with a total of 2 megabytes fitting on each expansion board. The PowerMate 1 can accommodate 8 megabytes of memory; the PowerMate 2, 10.

The ROM-based BIOS bears a Phoenix Technologies Limited copyright dated 1985, and the latest BIOS revision was dated February 27, 1987. This firmware code is contained in a pair of socketed 32K-byte ROM chips, with two vacant ROM sockets available for adding more ROM, per IBM practice.

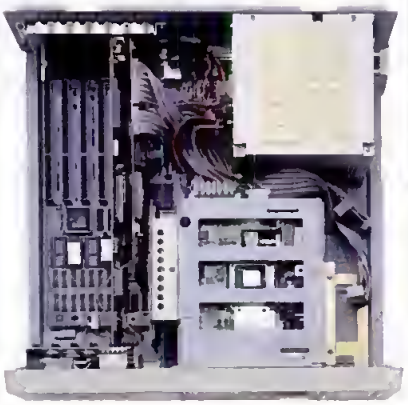
The PowerMate system board circuitry includes the standard communications ports. Both PowerMate models offer a single IBM-standard parallel printer port that terminates in a female DB-25 connector on the back panel. The PowerMate 1 gives you one serial port as standard equipment; the PowerMate 2 has two. Serial ports for both machines come with AT-standard male DB-9 connectors.

The floppy disk controller electronics are also part of the native endowment of the system boards of both PowerMates. A short ribbon cable plugs into the board, then runs to the drive. The cable of the PowerMate 2 has an extra connector for a second drive. The PowerMate 1 adds one further connector to this cable so that a 3½-inch drive can be plugged into it without an adapter.

All PowerMate models also include a built-in clock and CMOS configuration memory, both kept alive when the computer is switched off by a Panasonic BR-E2 6-volt lithium battery. The battery is attached to the rear of the system unit chassis with Velcro; and 6-inch leads, soldered to the battery itself, conduct its current to the system board.

■ NEC APC IV POWERMATES 1 AND 2

The APC IV PowerMate 1 is NEC's compact unit. It has a footprint of 6½ by 16½ by 16½ inches (HWD), or about 5 inches smaller than the IBM PC AT. But it runs only as fast as the 8-MHz AT prototype. Rather than using exotic circuitry to slim down the system unit, NEC has eliminated two expansion slots and placed some circuitry on a daughtercard.



FACT FILE

NEC APC IV PowerMate 1
NEC Information Systems Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(617) 264-8000
List Price: With 640K RAM, Intel 80286 microprocessor, serial port, parallel port, six full-size expansion slots, built-in clock and calendar, hard disk drive controller, one 1.2-Mbyte floppy disk drive, two 5¼- and one 3½-inch internal disk storage units, MS-DOS 3.2, GW-BASIC 3.2, $1,845; with all the above-mentioned features and keyboard, $1,995; NEC MultiSync monitor, $900; Color Graphics Board, $225; Advanced Graphics Board, $525; MultiSync Graphics Board, $649.
Requires: Display and graphics adapter.
In Short: A small-footprint AT compatible that operates at 8 MHz with one wait state. It features six expansion slots, standard half-height drive bays (one available), and a 3½-inch drive bay.

CIRCLE **700** ON READER SERVICE CARD

BOARD ROOM Rather than using exotic circuitry or revolutionary designs to slim down the PowerMate 1 system unit, NEC has eliminated two expansion slots and placed some circuitry on a daughtercard. Consequently the machine features six expansion slots, five of which use the 16-bit AT bus and the sixth, the XT-style 8-bit bus. The daughtercard is fastened to the left of the main drive bay with a steel bracket. Unaccountably, one of the VLSI chip sockets is unfilled in the PowerMate 1, a waste of space in a size-sensitive machine.

The larger PowerMate 2 holds eight slots, exactly copying the AT scheme: two use the 8-bit bus and the rest, the 16-bit.

All expansion slots in both machines are full-length and tall enough to accept full-height AT expansion cards. Card guides are built in for all slots. In the standard configuration of every PowerMate, one slot is occupied by a hard disk controller board even if the system is not equipped with a hard disk drive. And as with any system, you'll also need to fill a second slot with a display adapter.

Although the hard disk drive controllers used in the PowerMates are NEC implementations, they behave as functional equivalents of the Western Digital controller chosen by IBM. The PowerMate 2's circuitry is spread across a full-length (13½-inch) board; the PowerMate 1 controller uses a shorter card (10 inches long). Either controller can handle two hard disk drives.

The first time you boot up either system, an AUTOEXEC.BAT file on the virgin system disks checks the CMOS configuration memory and automatically sends you into the system setup program if necessary. The NEC setup software has a moving-bar menu system that you can use to change a value. It then prompts you to choose the appropriate responses from a listing. This is certainly a colorful improvement over IBM's austere AT setup program.

System installation is complicated by hardware matters. Both PowerMate system boards bear two banks of DIP switches, one of which you use for selecting hardware options. The other switch bank is undocumented.

Using the documented DIP switches, you can enable or disable each of the system board communications ports individually. Another DIP switch lets you select the monitor type, and another specifies the number of floppy disk drives—one or two—installed in the system.

Photographs: Les Morsillo

It's like having 256,000 in one box.

Back in the dark ages of personal computing, the world was ruled by numbers and words. Graphics were a nicety, but rarely a necessity.

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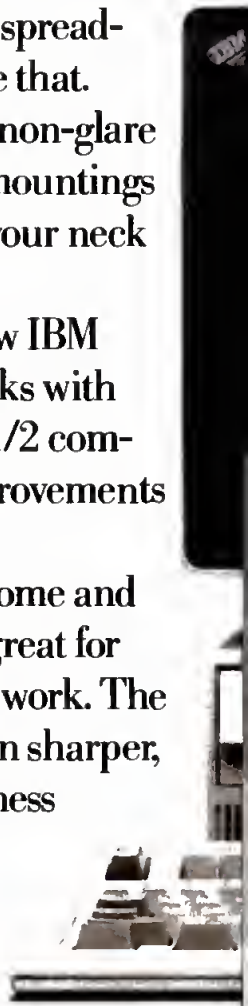

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crayons

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Just about any program you can run on the IBM Personal System/2 will look better, and will likely be more pleasant to spend time with. Many other programs are being reworked just to take advantage of the new graphics.

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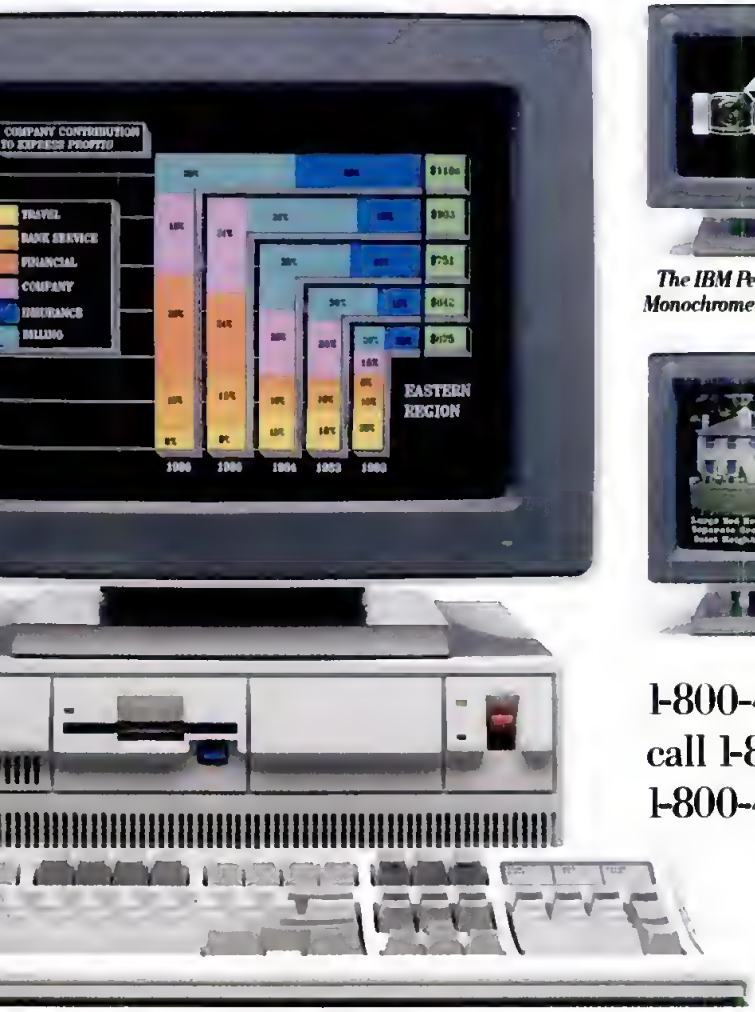


The IBM Personal System/2 Model 50 and the IBM Personal System/2 Color Display 8514.

The IBM Personal System/2 Monochrome Display 8503.

The IBM Personal System/2 Color Display 8513.

The IBM Personal System/2 Color Display 8512.

All screens are actual and unretouched.

■ NEC APC IV POWERMATES 1 AND 2

PC MAGAZINE FACT FILE

NEC APC IV PowerMate 2
NEC Information Systems Inc.
1414 Massachusetts Ave.
Boxborough, MA 01719
(617) 264-8000
List Price: With 640K RAM, Intel 80286 microprocessor, parallel port, two serial ports, eight full-size expansion slots, hard disk drive controller, one 1.2-Mbyte floppy disk drive, five internal disk drive storage slots, MS-DOS 3.2, GW-BASIC 3.2, $2,445; with all the above features and keyboard, $2,595; NEC MultiSync monitor, $900; Color Graphics Board, $225; Advanced Graphics Board, $525; MultiSync Graphics Board, $649.
Requires: Display and graphics adapter.
In Short: An 8- or 10-MHz (software selectable) AT compatible with exactly the same expansion options as the IBM original. It accommodates up to five half-height 5¼-inch drives.
CIRCLE 699 ON READER SERVICE CARD

The NEC APC IV PowerMate 2 is the speedster. It pushes the speed limit up to 10 MHz (but has one wait state) to give a 20 to 30 percent performance improvement over a top-of-the-line IBM PC AT. You can choose to run the PowerMate 2 at 8 or 10 MHz. However, this machine does nothing to free up your desk space.

BATTLESHIPS AND RIVETS NEC's design approach—or the lack of same—can be seen in the hardware of the two PowerMate systems. Under the lid of each—which you remove by sliding off to the rear, leaving the front panel in place—is a stamped steel chassis finished in a thin layer of battleship gray paint.

In both systems, the power supply occupies the location decreed by IBM: at the right rear. The PowerMate 1, however, features a smaller, almost cubical juice generator; that of the PowerMate 2 matches the IBM box in size and shape.

In both machines a large fan (its generous size accounting for the quiet operation of the system in general) inside the power supply cover dominates the rear panel. To its left (when viewed from the rear) are the power connectors—an input for line power and a switched outlet for plugging in a monitor. In between is a small slide switch for selecting the line voltage.

The power switch for each PowerMate shows through a large dimple in the steel system unit cover, on the right side near the rear per IBM practice. Instead of the big red paddle of the AT, however, both machines use gray rocker switches.

Despite the difference in the number of drive bays of the two systems, their mechanical construction is much the same. Both full-height bays, which are split vertically, are made from a rectangular tube with cutouts atop and channels in the sides to accept drive mounting rails. Much of the ancillary hardware for the drive bays is pop-riveted together.

In both machines the drive bays float above the bottom of the chassis, allowing part of the system board to hide underneath. The placement of the system board prevents the drive stack of the PowerMate 1 and the left stack of the PowerMate 2 from holding three half-height devices.

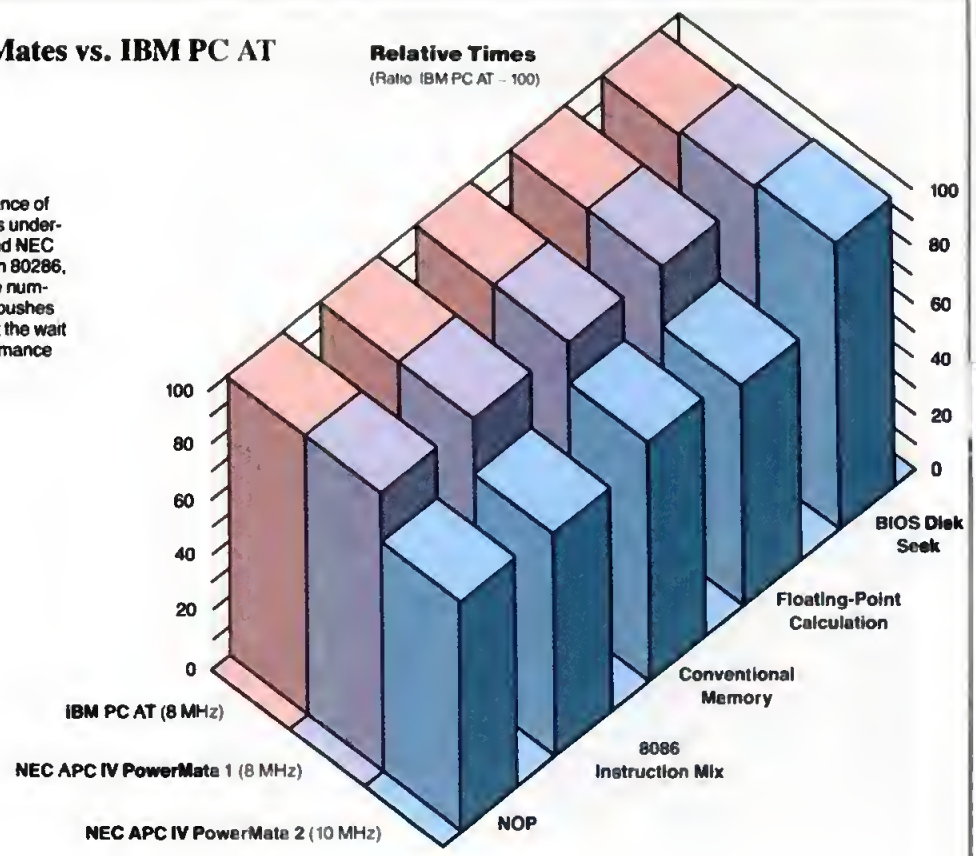
The mounting of the 5¼-inch drive units follows the AT pattern through the use of side-mounted guide rails, but NEC opts for its own proprietary specs for the shape and materials making up the hardware. The metal rails of the mounting butt hard against tabs at the rear of each bay.

Add-in NEC drives are sold as complete kits that include the appropriate rails, so the manufacturer supplies no spare rails with the machines themselves. However, the nonstandard mounting hardware adds yet another impediment to the venturesome add-your-own-disk PC owner who doesn't want his expansion options limited by a shortsighted manufacturer. (Or one that hopes to capitalize on expansion products by subtly closing the system to add-ins from other vendors.)

The optional 3½-inch hard or floppy

Benchmark Tests: NEC APC IV PowerMates vs. IBM PC AT

The PowerMate 1 matches the performance of the standard 8-MHz AT exactly, which is understandable considering that both the IBM and NEC machines use the same microprocessor, an 80286, operating at the same speed with the same number of wait states (one). The PowerMate 2 pushes up the speed limit by 2 MHz but doesn't cut the wait states; this yields a 20 to 30 percent performance improvement over a top-of-the-line AT.



Performance Times

(Times given in seconds except where noted)

	NOP	8086 Instruction Mix	Conventional Memory	Floating-Point Calculation	BIOS Disk Seek (milliseconds)
IBM PC AT (8 MHz)	4.2	9.0	1.3	35.6	37.2
NEC APC IV PowerMate 1 (8 MHz)	4.2	9.0	1.3	35.5	37.6
NEC APC IV PowerMate 2 (10 MHz)	3.4	7.2	1.1	28.1	38.0

The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The **8086 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 8086 instruction code. These instructions are a subset of the total processor instruction set.

The **Conventional Memory** benchmark test allocates 256K bytes of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

The **BIOS Disk Seek** benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

disk drive of the PowerMate 1 mounts on edge using a special bracket, already installed in the chassis. Ordinary screws hold the bottom of the drive in its appointed place.

Standard equipment in all PowerMate models includes a single high-density 1.2-megabyte floppy disk drive, manufactured by NEC. Either PowerMate may be augmented with any of a number of drives selected from a wide variety offered by NEC. For a second floppy, you can select double-density (360K) and high-density (1.2-megabyte) 5¼-inch models or a 720K-capacity 3½-inch model, which is adapted to a 5¼-inch form factor for installation inside the PowerMate 2.

Either PowerMate may optionally use a half-height, NEC-manufactured hard disk drive. Models with 20- and 40-megabyte capacities are offered. You can also add a full-height 66-megabyte drive to the PowerMate 2. A 3½-inch form factor 20-megabyte drive can also squeeze into the miniature drive bay of the PowerMate 1.

Both 20-megabyte models use two platters and four heads; the 40-megabyte, four platters and eight heads. All have 615 cylinders. The rated average access time of the 5¼-inch drives is 40 milliseconds, while the little drive drags along at 85 milliseconds.

The 66-megabyte hard disk has six platters, ten heads, 823 cylinders, and a rated average access time of 23 milliseconds. All of the hard disks use the ST-506 interface, which achieves a maximum possible data transfer rate of 5 MHz.

Both review PowerMates came equipped with NEC 20-megabyte half-height hard disks. Although the two drives were assigned different types using the setup utility when the system was configured (the drive in the PowerMate 1 was type 39; in the PowerMate 2, a type 2), they appeared to be physically identical and turned in identical times on the PC Labs benchmark tests: average access time was about 38 milliseconds, equivalent to the standard IBM AT hard disk.

PIANO PLUS 13 The standard NEC keyboard that's shared by both PowerMates is nearly an exact match of the IBM enhanced keyboard. Its layout features a total of 101 keys (13 more than a baby grand), with an upper row of 12 function keys, separate inverted-T cursor and combined numeric/cursor keypads, and a pair of Ctrl and Alt keys flanking the Spacebar on each side. At the upper-right-hand corner, indicators show the status of the locking shift keys.

Even the sound and feel of the standard IBM keyboard has been copied almost exactly. Anyone who's familiar with the IBM original will feel right at home on the NEC. Almost. The audible feedback sounds somewhat thinner, but the positive snap-action, over-center feel is right on the money.

Underneath, you'll find a couple of subtle mechanical differences from the IBM. The flipper-like feet that adjust the keyboard angle are different and only allow two slopes: flat or about 12 degrees. The cable is permanently attached and drops straight down from the bottom of the keyboard. Molded channels in the bottom of the keyboard route the cable off to either side. The length of the cable itself is unusually generous—about 3 meters. Most of it is coiled, but it has enough straight length to snake around from the rear of the system unit to where the keyboard connector lies.

ADVANCED GRAPHICS Perhaps the most impressive aspects of the PowerMate systems were the optional Advanced Graphics Board and Advanced Color Display that accompanied each evaluation unit.

Although the NEC video adapter has lost some of its appeal in today's supersharp world of VGA graphics, it's nevertheless a very able EGA-compatible board. The NEC Advanced Graphics board emulates all 17 of IBM's pre-VGA display standards—monochrome and color—up through EGA modes.

As is the case with the IBM product, you select the display type by using a bank of four DIP switches that peer through a small hole in the retaining bracket of the card. A full 256K of display memory is built into the adapter, as are connectors for the IBM-style enhancements that no one seems to use.

The Advanced Color Display is the real marvel because it's essentially NEC's MultiSync display with a few refinements. The 14-inch (diagonal) CRT uses a high-contrast black matrix and is anti-glare treated. According to NEC, it's capable of displaying on-screen resolutions up to 800 by 560 pixels. A swivel pedestal is built in. The usual user controls hide under a door in the top of the display and include brightness, contrast, vertical hold and size, vertical and horizontal position, plus switches to select text mode and an alternate horizontal width. On the rear panel are the power switch, DIP switches to select text mode color, and a toggle switch that permits either analog or TTL inputs to be used with the display.

As with the MultiSync, the Advanced Graphics Display accepts any horizontal scanning frequency between 15.5 and 35 KHz. Although its specifications list its maximum frame rate as 60 Hz, it will operate at 70 Hz as well, making it compatible with the VGA standard should you have the appropriate adapter cable.

In operation, it's bright, sharp, and stable. If the MultiSync weren't available separately, the Advanced Color Display might be reason enough to buy a PowerMate.

Perhaps that's the biggest problem with this computing twosome. The PowerMates have nothing in themselves to recommend them over the dozens of similar AT clones on the market. Certainly the PowerMates are great computers, but they're almost indistinguishable from the rest of the pack. They just show off Japanese copycat engineering at its best.

If there is any recommendation for the PowerMates, it is that they are part of a complete system manufactured by NEC. If you stick with NEC enhancements, you won't have compatibility worries. While other companies have tried the same strategy with varying degrees of success, at least NEC doesn't impose too much of a price penalty.

It's hard to be passionate about the PowerMates. Nothing about the PowerMates is refreshingly original, but nothing about them is damnably bad. They merely represent another option available when you shop for an AT-compatible computer to decorate your desktop.

Winn L. Rosch is a contributing editor of PC Magazine.

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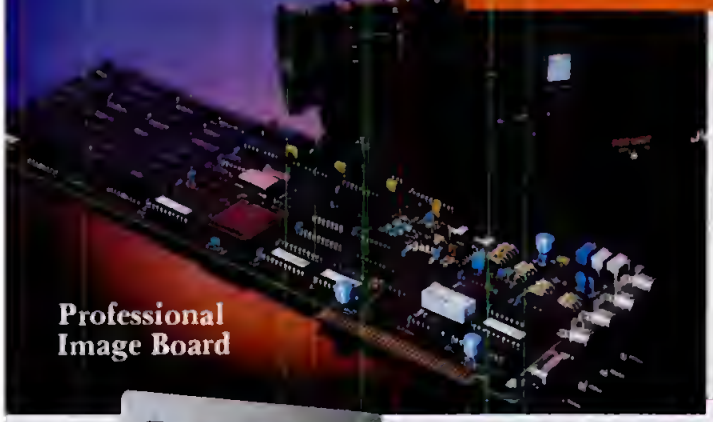

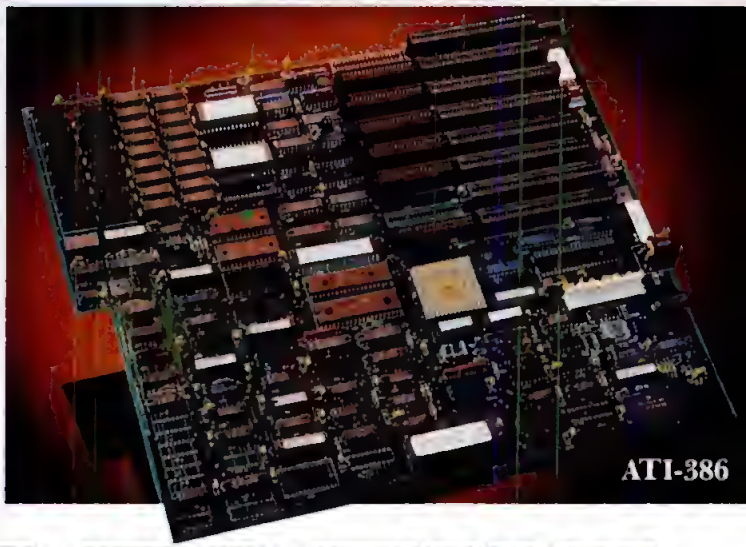

ADVANCE TO THE NEXT LEVEL

ATI-386

The ATI-386 AT board is a high-performance system board that provides the primary elements for building advenced personal computers. The board is functionally compatible with the system board in the IBM AT. However, it contains an 80386 microprocessor, 32-bit access to data and other features that give it over twice the performance of an 8MHz IBM AT.

Other features include downward compatibility with IBM 8 MHz AT, one MByte 32-bit on-board memory expandable to 16 MByte, a socket for the Intel 80387 math co-processor and more.

ATI-386-64

The ATI-386/64 Board features the same specifications as the ATI-386 AT board as well as on-board 64 KByte cache memory, cachable to a full 16 MByte memory space to achieve nearly zero-wait state operation at full speed.

ATI-6/12 System 286

The ATI System 286-12 runs at an amazing speed of 12MHz. That's 20% faster than the IBM* Personal System 2 50/60.

And to protect your existing investment, we've built-in a normal-speed mode as well. A few simple keystrokes will switch you to 6MHz operation mode, when necessary.

Combine the ATI System 286-12 with our MegaGraph Plus EGA board to get superb graphics performance. Or expand your system's main memory with the ATI Multifunction card. Expand from single-user to multi-user system with up to five disk drive slots and eight expansion slots. 6/8 & 6/10 MHz systems also available. **CIRCLE 265 ON READER SERVICE CARD**

12 MHz Multifunction Card

Our versatile multifunction card features a system bus of 12MHz. Sockets on board to handle up to 2.5 MBytes of memory, one serial port, one parallel port, one game port. Optional second serial port available.

Professional Image Board

The new Professional Image Board is a PC board which allows an ordinary home video camera (color or black-and-white) to be plugged into an IBM PC/XT/AT personal computers or IBM compatibles. Now, live, fast action scenes can be instantly captured in full color and frozen. The frozen pictures can be stored on a floppy or hard disk. The frozen pictures can also be transmitted to any remote computer in the world via modem or network.

ATI

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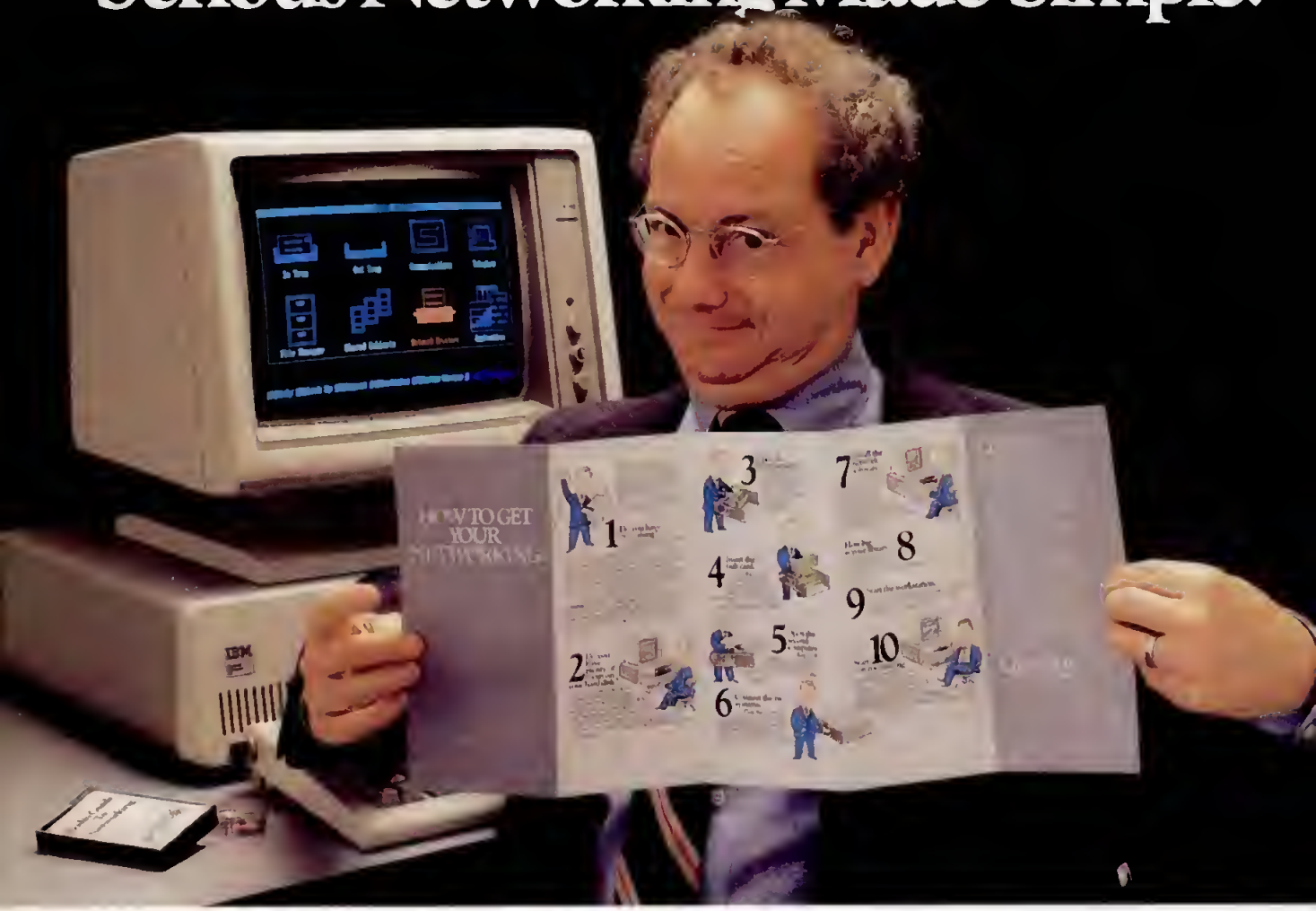

Despite all the claims, networking has stayed just out of reach for many people. Instead of simple and quick, you usually find complicated, confusing, and costly systems.

QuadStar is different. It puts networking where you can get a grip on it.

Easy to install and start

First, get your hands on the QuadStarter Kit. It includes everything you'll need: adapter boards, software, manuals, and cables. Plus simple, 10-step instructions in a convenient fold-out guide, a helpful audio tape, and other plain-English materials. In no time at all, you'll have the equipment in and the network up and running.

Simple to operate

Instead of confusing computer code, QuadStar and Tapestry operating system use simple icons, easy-to-understand symbols, like an "out box" to send electronic mail.

A real performer

At the same time, feel the full network power in your hands. QuadStar and Tapestry deliver all the performance you'll need to do serious networking—one work group now, more as your needs grow.

A price you can handle

It's even easy on your wallet. Station-for-station, QuadStar costs about half what you'd expect to pay for a network.

For simple, serious, affordable networking, choose QuadStar. See your dealer or contact Quadram at One Quad Way, Norcross, GA 30093. Telephone 404/564-5566.

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CIRCLE 189 ON READER SERVICE CARD

■ CONNECTIVITY: A CONTINUING SERIES ■

MAKING CONNECTIONS

Voice-and-Data PBX SYSTEMS

If your connectivity needs stop at swapping files and sharing equipment, you could be overlooking a powerful solution. Hooked up to a voice-and-data PBX or to a central-switching service, your humble telephone wires can be used to make hundreds of connections a day.

■ FRANK J. DERFLER, JR.

Anyone trying to cut through the thicket of connectivity options these days faces an unenviable task. For local area networks alone, there are dozens of systems out there to choose from. It's enough to drive even the coolest-headed corporate PC buyer close to distraction.

Yet there's another option for connecting computers that many PC buyers overlook—the office telephone system. Hooked up to a voice-and-data PBX or to a central-switching service known as Centrex, those humble telephone wires can become powerful connectivity tools, permitting dozens of daily connections with very little fuss. Though it can't handle certain high-speed, data-heavy workloads (such as running a networked DBMS), a voice-and-data PBX offers uncommon flexibility when it comes to routine file swapping and equipment sharing and can provide a way to network slotless laptop PCs. If your needs stop there, and especially if your company is looking to upgrade its current phone system, you should at least consider one of these telephone-switch systems.

In this issue of *PC Magazine*, we take an in-depth look at voice-and-data PBX and Centrex systems—what they are, how they work, and what they cost. We follow that up with our reviews of systems from Siemens, Mitel, Shared Resource Exchange, and Northern Telecom, and we discuss the Centrex system. With a little background, even confirmed computer users may begin to truly appreciate the power the telephone is capable of.

■ VOICE-AND-DATA PBX SYSTEMS

LAN VERSUS PHONE It's relatively easy to spend $1,000 per station for a media-sharing LAN. Indeed, if you include all of the costs—interface cards, hubs, wire, and labor in a city like New York—the total can exceed $2,000 per station for, say, the IBM Token-Ring Network. Some networks, including AT&T's StarLAN, Corvus's Omninet, and Fox Research's 10-NET, can save you time and money by using the twisted-pair wiring that might already be in your building's walls. But all of these networks have significant distance limitations, all require an interface card (taking up a valuable expansion slot) for every workstation, and StarLAN requires two pairs of wires. A data PBX (see "Making Connections: Data PBXs," *PC Magazine*, Volume 6 Number 13) can save you an expansion slot and the cost of an interface card, but you'll need to install multiconductor cable (usually eight wires). In addition, while some data PBX systems can service over 1,000 nodes, they are more typically used to connect work groups with fewer than 32 nodes.

The one connectivity device available on every desk of every office in the United States is the telephone. Its wiring is usually in place and paid for, maintenance has been taken care of, and people are familiar with how the system operates. Many modem telephone systems can also pass data among groups of PCs and between PCs and other digital devices, without modems, network interface cards, or additional special wiring. RS-232C serial connections handle the data without regard to the internal architecture or even the operating system used on the terminal devices. Modem voice-and-data switches, or digital PBXs, can send data over a single strand of twisted-pair wiring stretching as far as 4,000 feet. These switches operate at speeds ranging from 19.2 kilobits per second to as high as 64 kilobits per second in some configurations. For many applications, such telephone systems are a flexible and economic alternative to media-sharing LANs.

Modern PBXs (private branch exchanges) are a world away from their earliest counterparts. Those first switches operated using a series of electromechanical relays and rotary stepping devices; a switch able to service several hundred instruments could fill a small house. Today's voice PBXs contain 8-, 16-, or 32-bit processors, floppy disk drives, and special operating systems. Typically, these computers run solid-state matrix switches that connect telephones and pass along their analog voice signals.

The latest generation of PBX systems operates completely on digital principles. You can think of a voice-and-data PBX as a microcomputer or minicomputer having many analog-to-digital converters (telephones) as peripherals. These peripherals send coded messages (the dialed numbers) to the switch, which interprets them, using a program running on its computer. In response to the messages, the program routes data among the peripherals (connects the telephones). You can also hook up computers and other serial devices through a voice-and-data PBX—and you'll find some significant differences from the typical LAN scheme. Unlike a LAN, in which all stations share the same wiring through a complex access protocol, a PBX is a circuit-switch system that makes connections on a one-to-one basis, only for the period those connections are needed. There's no central server for storing and sending files; instead, you retrieve files directly from the remote stations, using the PBX as a conduit. PBX software takes much less work to set up and run—in fact, from the PC user's perspective, ordinary communications software is about all that's needed.

■ You can think of a voice-and-data PBX as a computer having many analog-to-digital (telephone) converters as peripherals.

NEW DECK OF CARDS With a PBX, you'll also avoid taking up precious slot space with LAN interface cards. The PBX interface hooks directly into your computer's RS-232C serial port. In fact, this feature makes a telephone-switch system ideal for connectivity among the increasingly popular laptop PCs, which, though they have serial ports, have no slot space.

Voice-and-data PBXs do have their own equivalent to PC expansion cards, however. Called line cards, these circuit boards plug not into the back of your PC, but into the bus structure of the switch itself. You can expand the switch's capacity by putting more line cards into its cabinet or by adding more cabinets to hold still more line cards. A line card performs a number of different jobs, and, as with network interface cards, different manufacturers arrange the tasks differently within the switch. Some line cards can connect with only one telephone instrument; others can hook a dozen or more instruments to the switch. Some line cards contain enough on-board processing power and programming to send a connection message to any attached digital device making a call; others pass that task to the switch's processor and software. Some line cards buffer and process the data they receive; others leave those jobs to the main CPU and memory. It's basically a pay-me-now-or-pay-me-later proposition: sophisticated line cards make expanding the switch more expensive, but switches with simple line cards have a higher initial cost.

CAPABILITIES Although voice-and-data switches differ greatly from LANs, they can perform many of the same functions with a very modest complement of PC software. Basically, the programs you need are simply the ones that move data into and out of serial ports. For file transfer and terminal operation, you can use whatever communications program you're used to—*Crosstalk*, *PC-Talk*, *Relay*, or one of the other popular packages. Typically, the terminal mode is used to establish contact with the telephone switch and transmit the digits of the number to be called. Files can be exchanged using Xmodem and other error-detection protocols. For unattended operation, programs like *Remote*, *Carbon Copy*, and many others can be used.

You can also easily share printers, plotters, modems, and other devices through a

telephone switch. Indeed, the distance between the PC and the shared printer doesn't matter in these systems, so a laser printer across the country can print out your work as easily as one around the corner—in effect, you can have a laser-quality fax machine. Printers can be shared through a telephone switch in several different ways. Word processing programs can pipe their output to a file, which can then be transmitted to the printer as a separate action. In a more automated mode, many word processing programs allow the transmission of printer setup strings as actual calls to the switch. And programs like *EasyLAN*, which work in the background mode of a computer and route data out the appropriate port, can give you fully automated equipment sharing.

APPLES TO PCs Because the RS-232C port is a common signaling standard, Apple Macintosh and Wang PC computers can exchange files with IBM PC–type computers through a telephone switch. Apple IIs and IBM PCs can also share printers, modems, and other peripherals. The telephone switch thus can solve the multivendor connectivity problems present in many organizations. Also, you can use several different techniques to access host mainframes and minicomputers through a telephone switch; public data networks providing long-distance services can be reached in the same way.

With DOS batch files and the script-file capability available in modem communications programs, you can execute file transfers and equipment sharing easily, and the process is nearly invisible. The PC software can give you password security, while software in the telephone switch can provide connection security by limiting access to certain numbers. And a telephone switch allows hundreds of users to share electronic mail, group calendaring, and other group productivity services.

For some applications, however, a telephone-switch system may not be your best bet. Running a networked DBMS—inventory accounting, reservation systems, order taking, and other tasks requiring fast, on-line access to a shared database—for example, should not be done on a voice-and-data PBX. The transmission rate these switches currently use (19.2 kilobits per second) is generally too slow to support the many transactions needed in an on-line database system. It's worth pointing out, however, that as the PBX industry advances, transmission speeds should increase to 64 kilobits per second. At that rate, database applications might be feasible on PBX systems.

MANAGEMENT TOOL A voice-and-data PBX can also give you a few goodies that a LAN can't. The most important of these is a management tool that's lacking in typical PC-based local networks: station message detail recording (SMDR). With SMDR, you can find out what traffic is passing through the switch and who is using the resources. You can generate a report in almost any format to show specific data or broad trends. You can analyze call-traffic patterns, monitor the activity of a single station or work group, and compile a summary of your observations. SMDR helps managers see who causes the load and how the system handles it, allowing allocation of costs back to specific profit and cost centers and permitting the ordering of new equipment before there's a resource squeeze. These are certainly tools that managers of media-sharing LANs could use—if they could get them.

■ You can easily share printers, plotters, modems, and other devices through a telephone switch.

As dedicated computer systems, PBXs can furnish many other customized services. They are often programmed to allow reduced-digit dialing—one, two, three, or four digits instead of the usual seven. Call waiting, queuing, forwarding, and interception are typical PBX services. Most of us, phoning for airline reservations, have experienced PBX-provided music-on-hold and automatic distribution of calls to a pool of service agents. Changes to programs in the PBX allow people to move to different offices and keep the same number and services. Other program instructions can limit the ability of specific phones to make certain types of calls.

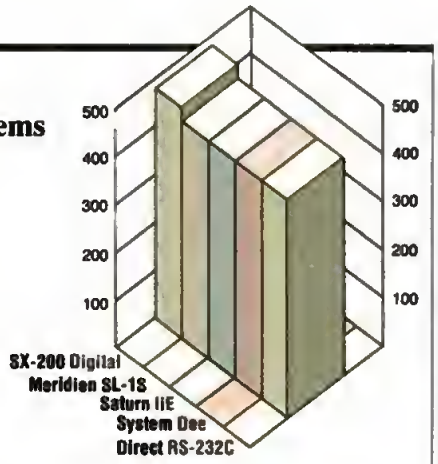
HOOKING UP In most cases, modem voice-and-data PBX systems convert the analog voice signals into digital signals, which are passed over twisted-pair telephone wire. This is done in the telephone by a device called an encoder/decoder, or "codec." A codec is the opposite of a modem (modulator/demodulator); it takes an analog signal and makes it digital, while a modem takes a digital signal and converts it into analog tones. Be aware, however, that some PBX systems that advertise themselves as "digital" take the analog voice into the telephone switch, make it digital for passage through the computerized switch, and then convert it back to analog on the way out of the switch. To connect a PC to these systems, you'll still need a modem.

One advantage of having a codec in the telephone instrument is that the whole system can be used for passing digital data in addition to digitized voice. Some codec-equipped telephone instruments associated with modem PBX systems have a DB-25 connector right in the back of the phone. To connect your PC to one of these PBXs, you simply run a short RS-232C cable from the back of the PC to the back of the phone. Connection to other digital phone/PC systems, or to printers, plotters, modems, mainframes, and other serial devices, is accomplished by loading a communications program in the PC and sending the dialed number to the telephone switch. Computer calls are as easy to make as voice calls.

PBX systems vary in how the computer devices connect to the switch and in how many wires are used to make the connection. Some systems, like Northern Telecom's Meridian SL-1S and Mitel's SX-200 Digital, put voice data and computer data on the same pair of wires. Others, like Siemens Information Systems' Satum IIE and the System One, from Shared Resource Exchange, do not integrate the voice data and computer data and require a second pair of wires for the computer sig-

Performance Tests: Voice-and-Data PBX Systems

Nearly all of the systems tested here showed the same results on these performance tests. This shows that the switch has no effect on the data transfer rate.



Performance Times
(Times given in seconds)

System	Software	Server	File Transfer
SX-200 Digitel	*EasyLAN*	8-MHz IBM PC AT	479
Meridian SL-1S	*EasyLAN*	8-MHz IBM PC AT	454
Saturn IIE	*EasyLAN*	8-MHz IBM PC AT	454
System One	*EasyLAN*	8-MHz IBM PC AT	454
Direct RS-232C cable connections	*EasyLAN*	8-MHz IBM PC AT	454

In PBX systems, unlike media-sharing or zero-slot LANs, the speed of the connection is dictated more by the switch than by the load on the shared resources in the server; hence we tested the speed of the switch.

We ran these **File Transfer** performance tests between an 8-MHz IBM PC AT and a standard IBM PC. The time shown is the number of seconds it takes to transfer 12 files of various sizes (totaling over 360K bytes) from a RAMdisk on the AT to a RAMdisk on the PC through the PBX. The 19.2-kilobit-per-second transfer rate used is the highest one recommended for the switch.

These voice-and-data switches don't come with their own file transfer software. However, the systems from Northern Telecom, Shared Resource Exchange (SRX), Siemens Information Systems, and Mitel are compatible with the *EasyLan* RS-232C networking software, so we used *EasyLAN* to perform our file transfer tests. For comparison, we have included the time for the same file transfer using *EasyLAN* operating at 19.2 kilobits per second with a direct RS-232C cable between the systems.

We had intended to run the test twice (as we did last issue for data PBX systems), the second time with the switch loaded heavily to show degradation. After assembling more than a dozen PCs at one location, we found this to be impractical. These switches either make the connection through a matrix or allocate sufficient bandwidth on a data bus to accommodate a full complement of attached devices transmitting at 19.2 kilobits per second. We could detect no effect from loading.

nals. Combining voice data and computer data on the same pair of wires has no inherent operational drawbacks; there is enough capacity in a wire pair to provide good simultaneous service to both data sources. However, integrating data from two sources and subsequently separating the data streams at the switch requires more-complex electronic components. Because of this, some switches that use codec-equipped telephones still use a separate interface device and a separate pair of wires to connect each computer or other digital device to the switch. This poses no real problems, because usually buildings have plenty of wires installed to accommodate this scheme.

THE CENTREX/CO LAN OPTION If the voice-and-data PBX looks like a possible solution to your company's connectivity problems, you should take a look at another alternative that may be available from your local phone company. While the "interconnect" companies in the PBX industry were developing and installing small computerized PBX systems, a tangle of legal and regulatory restrictions kept the local regulated Bell telephone units from competing directly in the PBX marketplace. Their alternative was to use a different level of technology to achieve the same results. The local telephone companies essentially lease portions of their own large central office switches, which are designed to serve entire communities. These switches have redundant processors, battery backup, excellent maintenance, security, and other features difficult to equal in a PBX installation. This leasing system is marketed under the trade name of Centrex.

If an organization uses Centrex services instead of installing a PBX, the computer in the telephone company's central office is programmed to provide special capabilities to that group of users. Their phone lines extend from their building to the central office switch, as with most telephone customers, but their calls are treated differently. The different treatment makes it look, to the users, as if they have a dedicated portion of the resources of the central office—or, in effect, their own PBX. The advantages of using Centrex instead of buying a PBX include low up-front costs; easy and low-cost expansion of services; a single fee for all services, including maintenance; very high reliability; wide-area coverage; and few requirements for extra floor space or environmental controls. The elimination of the investment tax credit under the new tax law—a blow to PBX vendors—was a boon to the Centrex market.

In the area of computer connectivity and digital services, the Centrex companies have kept up with the PBX manufacturers: specialized central office services for interconnecting computers, terminals, and other digital devices are marketed under the name CO LAN (Central Office Local Area Network). Various techniques are used to provide CO LAN services. In the central office, a digital switch either is dedicated to a single customer or is shared among several customers. This switch provides complete data-switching services. Typically, a digital link that's able to carry megabits of data per second is established between the customer's location and the serving central office. The connection can be made using twisted-pair wire, coaxial or fiber-optic cable, or microwave radio. The high-quality link can carry dozens or even hundreds of simultaneous telephone conversations and transmissions of computer data.

On the desktop, the setup and operation of a CO LAN is identical with that of a voice-and-data PBX system. The PC's serial port connects to the Centrex system through an adapter that might be a stand-alone device like a modem or might be a part of the telephone instrument. The system operates like a PBX; connections are made by passing digits to the switch. You can also get PBX-type features, such as the ability to dial a number using only four digits. We'll take a closer look at the CO LAN alternative in the sidebar "Call the Phone Company for Connectivity."

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THE OUTSIDE WORLD Large organizations often need to connect their terminals and PCs to high-capacity leased circuits that link operating locations nationally and internationally. They also often use public data networks employing the international X.25 standard for signaling and transmission. Designers of media-sharing LANs have to include communications gateways (often dedicated PCs) in their networks to interface with X.25 and leased-line communications networks. Voice-and-data PBX and CO LAN systems, too, can provide excellent interfaces to the outside world. By their nature, these switches allow orderly access to specialized ports and interface devices that can be dialed like any other telephone number.

Media-sharing LANs also use gateways to connect to mainframe host computers. By contrast, a telephone switch can connect to a host computer in one of three ways. If the host has serial RS-232C communications ports (like Digital Equipment's VAX systems), you can simply hook it up to one port on the switch and dial its number, as with any other digital device. If the host uses a unique communications scheme (as does IBM's 3270 SNA), the switch can connect PCs to a standalone device called a protocol converter, which mediates between the PC's ASCII asynchronous data stream and the IBM host system's EBCDIC synchronous data flow. Finally, a data switch can connect PCs needing terminal service to one PC acting as a gateway, using the same types of multisession gateway software and hardware used on media-sharing LANs. The EasyLAN zero-slot LAN communications can be used in this role, because it has the same NETBIOS interface used by Novell, IBM, and 3Com networking software.

ISDN COMPATIBILITY There's one other factor to consider if you're looking into a telephone-switch system—the proposed Integrated Services Digital Network (ISDN), an internationally sponsored plan to replace analog communications systems around the world with completely digital services. The RJ-11 jack in the walls of your home and office is the ISDN-standard device planned as your gateway to all-digital communications. Any digital device—a PC, fax, or telephone—will someday plug into that jack and connect to 64-kilobit-per-second data service.

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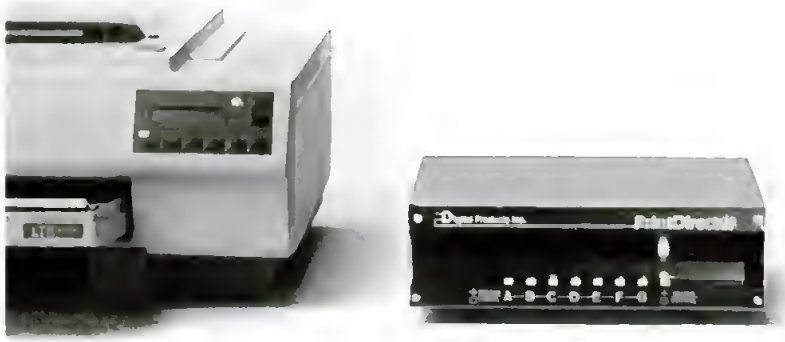

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companies and communities, however, local ISDN service is available today, and telephone companies and switch manufacturers are working with commercial companies and institutions to develop ISDN equipment and techniques.

Several PBX manufacturers advertise their switches as being "ISDN ready." Essentially, this means they provide the two 64-kilobit-per-second and single 16-kilobit-per-second ISDN connections that will be used in the United States. If you're buying a switch to be installed in a large corporation, government office, or institution in a major urban area, you'll have to consider ISDN compatibility. ISDN services will be available in big cities first, and large corporations will probably be able to use them effectively.

DIALING FOR DOLLARS Does the PBX or CO LAN solution to PC connectivity cost less than media-sharing LANs? Probably yes—but it's difficult to give an absolute answer, because costs can be allocated in many different ways. What percentage of the price of the PBX, for example, do you allocate to the area of PC connectivity? Additionally, PBX prices are almost always quoted as "installed," and CO LAN prices are always quoted that way. PC LAN buyers normally, but inaccurately, think of the cost of the LAN as the cost of the hardware and software, ignoring installation and integration expenses.

A voice-and-data PBX with digital instruments can cost from $300 to $800 per port installed. After that there's a per-PC cost for some kind of digital interface that takes the PC's data stream and sends it to the switch. The interface can be added to the telephone, can be in a separate box, or can be a PC expansion card; the average cost is $300. On the other hand, the latest StarLAN cards from Western Digital and AST Research retail at slightly over $300; Ethernet cards will soon be available from Novell and other companies at about the same price. Thus, once the cost of the basic telephone system has been absorbed, the incremental expense of adding computer connectivity is quite similar for both telephone switches and media-sharing LANs.

A major question for any installation is, how much will the wiring cost? If the cable or twisted-pair wire is already in the walls and paid for, the incremental costs will look much different from the costs when new wiring has to be installed. One final cost consideration regards software. If you don't really need the complexity of full multiuser networking software, with its significant installation and upkeep workload, then the simple multivendor interface provided by the telephone switch can give you a significant cost advantage. When comparing costs, don't just look at equipment and software prices—the time spent by talented individuals in maintaining the network can be a significant hidden expense.

■ A 336-port system, the SX-200 Digital provides integrated voice-and-data communications for operation with up to 250 telephone instruments.

WHO BUYS WHAT? As this introduction has tried to illustrate, connecting PCs and other digital devices together through a PBX or CO LAN can be a smart business decision. You avoid many of the software and equipment integration problems inherent in a media-sharing LAN, gain flexible connections, and may even save yourself some money (particularly in manpower requirements). But if that's the case, why do the people making decisions about how PCs are connected together so seldom consider this altemative? There are several reasons—ones usually connected with intemal politics and policies rather than with technical capability.

One problem is that the traditional retail outlets and sales forces that sell PCs to large accounts don't sell voice-and-data switches, because their customers don't ask for them. The PC buyers don't ask for them, in turn, because they don't buy telephones and hence don't understand the potential of telephone switches. And the organization's buyers of telephone services usually don't make decisions about how PCs will be connected. Another real difficulty in marketing PBX systems is that the PBX people have a comucopia of options and acronyms guaranteed to make an MS-DOS hacker pipe his FAT to NUL. Just ask a PBX salesperson if you can do CMU (customer memory update) through DID (direct inward dial) if the SNAP (special night answer position) is turned on. Making matters worse, different manufacturers call the same thing by different names.

In the hope of making these useful systems more accessible, we review four of the telephone connectivity products available today. These reviews are in alphabetical order by company name.

MITEL INC.

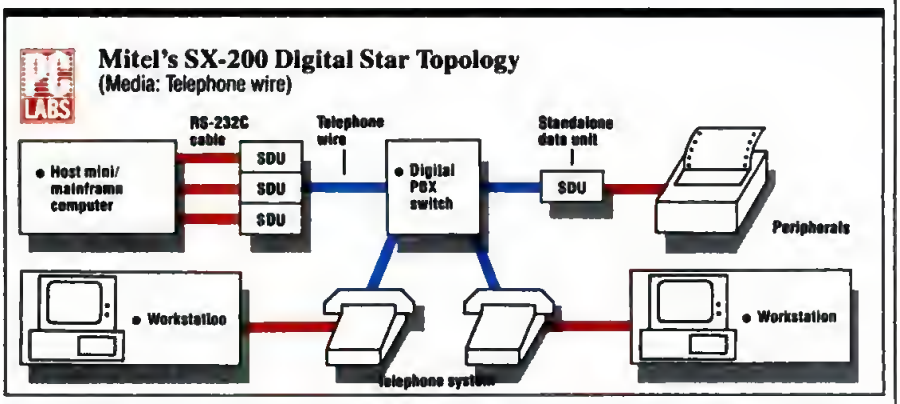
SX-200 Digital

Mitel, a Canadian entrepreneurial switch company that showed spectacular growth, has had some well-publicized difficulties in recent years. Its future received a big boost, however, when the huge and very solid British Telecom Corp. acquired 51 percent of it in 1986. Mitel's PBX product line includes very small switches—such as the SX-10 and SX-20 Superswitch, which can take a maximum of 48 lines—and some larger ones as well.

The switch we looked at is the SX-200 Digital, the latest version of a family of switches first introduced in 1978. The 1987 versions of the switch have maintained plug-in compatibility (in the line-card frame and the motherboard) with the entire product line, although a new internal architecture is used for the voice-and-data systems. Interestingly, the people at Mitel showed us an operational SX-2000 switch (larger than the SX-200), over 12 years old, that had shiny new line cards and other components installed on the same bus with the original cards. The claims of backward compatibility and modem expansion do indeed seem genuine. (You have to wonder what kind of expansion boards you'll be able to buy for the original PC 10 years from now!)

A 336-port system, the SX-200 Digital

provides integrated voice-and-data communications for operation with up to 250 telephone instruments. The SX-200 Digital uses a Motorola 68000 processor on its main control card. The Motorola 68000 has access to 2 megabytes of memory and two high-density 5¼-inch floppy disk drives. The basic SX-200 Digital equipment cabinet is 38 inches high, 23½ inches wide, and 27½ inches deep. A peripheral cabinet can sit on top of the main cabinet; each cabinet features several shelf options. Mitel says that its SX-200 Digital is ISDN ready. The switch's internal architecture operates in the ISDN format of 64-kilobit-per-second and 16-kilobit-per-second circuits.



Mitel's SX-200 Digital voice-and-data switch (below) can connect with PCs, printers, modems, and other devices through a telephone interface or a standalone unit. The PC and the interface connect through RS-232C cable. The connection from the interface to the switch is made over telephone wire. A single telephone-wire pair can carry both voice and computer data.

CONNECTIVITY OPTIONS The SX-200 Digital gives you several options in connecting a PC, printer, or other digital device to the switch. Data modules that accept an RS-232C connection can fit into the telephone instruments, or a standalone data set can be used for printers and computers that never need a voice telephone. The latter data set can connect two RS-232C devices to the switch. The Mitel data sets can automatically adjust to different bit-per-second rates and different parity settings for the connected equipment. The switch controls the data flow, so it can moderate speed differences between, for example, a PC and a modem.

Voice and computer data go over the same pair of wires. The signaling scheme uses 64-kilobit-per-second transmission between the data set and the switch. Controlling this link are proprietary integrated circuits on the line card and in the digital set that establish what Mitel calls the digital network interface circuit (DNIC). The DNIC format can be used over 1½ kilometers of wire. This integration of the switch and the DNIC chips has many benefits and a few potential problems.

On the positive side, the switch can interact with the processors and special keys in the telephone through the data stream. If a telephone needs specific programming or a specific configuration, the instructions are sent over the same data stream. This allows excellent flexibility and a wide set of alternatives.

On the negative side, in the normal configuration of the switch, hitting Ctrl-D gets the switch program's attention. After a Ctrl-D, the switch buffers data and tries to interpret the message. If it thinks it's found something like a request for setup from a telephone, it will send back a stream of its own data instructions. If you use a data communications product that employs Ctrl-D (as the *EasyLAN* software does), you will face exasperation in your attempts to communicate unless you change the character in the program or in the switch.

To make a data call through the system, you can use either a telephone or a keyboard and screen. When the RS-232C port becomes active, the switch puts an asterisk on the screen and requests the destination of the call. The switch furnishes information on the progress of the call and gives

PC MAGAZINE FACT FILE

SX-200 Digital
Mitel Inc.
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(305) 944-8500
Typical Installed Price: $78,000 for system able to handle 50 simultaneous voice-and-data exchanges plus 15 voice trunks (100 users, each simultaneously transmitting voice and data to one another). Price includes wiring, training, instruments, attendant console, and full installation.
Requires: RS-232C serial port.
In Short: Mitel's strong line of voice-and-data PBXs features a proprietary IC-based network interface circuit. The line of phones is attractive, and the system works well; however, our tests did show a consistent 5 percent speed degradation compared with a straight RS-232C hookup.
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you other options if the dialed number is busy.

PROGRAMMING The SX-200 Digital is programmed and controlled through a terminal that responds to the DEC VT-220 screen and keyboard commands. To set up a port for computer communications, you use the menu-driven command structure to tell the program in the switch which data ports are assigned, and what logical number, restrictions, privileges, priorities, and features to give to each port. In addition, the attendant's console can be used to make changes and updates to the system.

Dozens of features are available to ports and telephone instruments, including common things, like hotlines and call forwarding, and not-so-common things, like messages to a person already using a phone that tell him who is waiting in a call queue. Executive features ("Let somebody else answer it"), overrides of executive features ("You answer it"), and exotic functions like call swapping and call splitting can all be assigned through the menu program and used from the telephone instruments. However, one nice thing about a telephone PBX (compared with a media-sharing LAN) is that you can ignore all of these special features and still have a very effective system.

Mitel calls its line of telephones for the SX-200 Digital the "Supersets." They vary in styling and price, but all use programmable "soft keys" (like special function keys on a PC) that can perform different functions. Some Supersets have LCD screens, some have internal data sets and RS-232C interfaces, and many have options like speakerphones. They are attractively styled and provide efficient access to the network's capabilities.

The SX-200 Digital switch is a pleasure to use and to program. We tested the switch with both standalone data sets and data sets internal to the telephone instruments. In our tests of raw throughput, we did find a very small (5 percent) but consistent increase in the time needed to pass data through the system compared with that needed in a direct RS-232C connection. This delay, while technically interesting, would probably not be significant or even noticeable in an operational installation. To give the system an extra load, we whistled and yelled into the phone sharing the twisted-pair line with the computer data but saw no effect.

Mitel's SX-200 Digital system is attractively styled and really packed with features. It moves data efficiently, and is very capable of taking you into the ISDN environment of the future.

NORTHERN TELECOM INC.
Meridian SL-1S

Northern Telecom is a big name in the PBX business. It has more than 20,000 employees in the United States—in 14 manufacturing plants, 15 R&D centers, and over 100 marketing, sales, and service offices. The company's Meridian SL-1 PBX family alone has six million lines of service installed in 65 countries. That family includes four product levels, defined mainly by the number of lines the switches will service. The Meridian SL-1S services 32 to 80 lines in its basic form; the SL-1MS handles 80 to 460 lines; the SL-1NT can carry 400 to 1,500 lines, and the SL-1XT can service 1,000 to 5,000 lines. An even larger series of switches, the SL-100 can meet your telephone requirements should they run to 30,000 lines.

We reviewed the Meridian SL-1S,

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

Meridian SL-1S
Northern Telecom Inc.
2305 Mission College Blvd.
Santa Clara, CA 95054
(408) 988-5550
Typical Installed Price: $85,000 for system able to handle 50 simultaneous voice and data exchanges plus 15 voice trunks (100 users each simultaneously transmitting voice and data to one another). Price includes wiring, training, instruments (digital telephones), attendant console, and full installation.
Requires: RS-232C serial port.
In Short: A powerful and flexible connectivity alternative for a good-sized office. This voice-and-data PBX lets you hook your PC directly into one of its telephone units, and includes numerous useful options. The system is easy to use and program
CIRCLE 658 ON READER SERVICE CARD

which would be appropriate for an organization of approximately 100 users. The basic Meridian SL-1S, capable of servicing approximately 80 lines (depending on how they are split among voice, data, and outside trunk lines) measures about 24 inches wide, 24 inches deep, and 32 inches high. The base tier contains power supplies, the processor and disk drives, and some connections for line cards. A second-tier cabinet, about 17 inches high, holds additional line cards that can increase the system's capacity to 240 lines. Adding another line-card cabinet makes the entire switch 66 inches high and gives it a total capacity of 400 lines.

The Meridian switch family uses a matrix of four 2901B 4-bit processors that perform operations on 16 bits of data at a time. A basic machine has enough RAM to handle 256 16-bit-wide words. The operating program is a proprietary system called High Level Language (HLL), developed by Northern Telecom's R&D affiliate, BNR. The switch's usual configuration includes two floppy disk drives and an optional 20-megabyte hard disk; the primary value of the latter is to cut the time needed to reload the system software in the event of a processor or RAM failure. Telephone switches traditionally use batteries to provide backup power, and the power supply in the Meridian switch can be sup-

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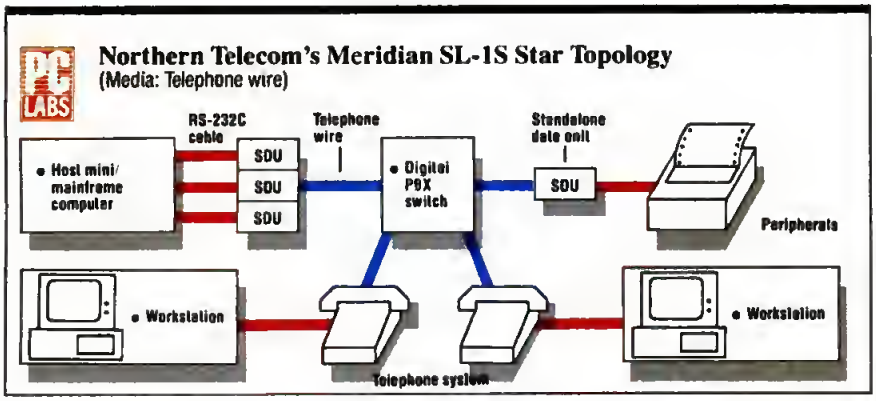

Northern Telecom's Meridian SL-1S switch can connect with PCs, printers, and other devices through a telephone interface (below) or a standalone unit. The connection between the PC and the interface is made through RS-232C cable. The connection from the interface to the switch is made over telephone wire. A single telephone-wire pair can carry both voice and computer data.

plemented with batteries that are able to provide 30 to 45 minutes of operation in the event of a total power failure. This communications system is probably much more reliable than the computers it services.

DIRECT HOOKUP Connecting a PC to the Meridian is a real pleasure. Northern Telecom has telephones that include the interface needed for a direct RS-232C input. One of those phones, the M3000, looks like something from the Sharper Image Catalog: It has a sleek black-and-grey finish, an optional speakerphone, and a large LCD panel that puts those of some laptop PCs to shame. It also has many features programmed into special keys on the LCD panel—you can, for example, select between voice, data, and intercom calls just by touching a name on the LCD screen.

Voice and computer data travel from desktop to switch on the same pair of wires. When you make a computer-data call with this switch, you simply activate the RS-232C port, and firmware on the line card sends out a message asking what number you want to call. This message can serve as a prompt to start a script file in a communications program; alternatively, the person using the terminal can simply type in the desired number. At the other end, an incoming call on the data line does not cause the phone to ring; instead, the switch opens the RS-232C connection between the two digital desktop systems. If the system receiving the call is busy, the caller gets a special message—which, again, can be used to initiate a response from a script file requesting that the switch put the caller on a queue of calls to the dialed number or requesting an alternative number.

If the line card detects three short break signals or a 1.6-second break, it will disconnect. Northern Telecom has worked with companies marketing communications software to ensure that the functions of the switch are available to PC users. For example, the 1.6-second break is now available from a script file in Version 3.61, and later, of *Crosstalk*.

LANSTAR/PC Northern Telecom has designed a complement to the SL-1 and SL-100 switches—a complete local area network system that uses the switch capabilities. We will cover LANstar more thoroughly in a future issue, but briefly, this is a hardware-and-software system that provides services typical of a media-sharing LAN—such as database access at high speed—through the data switch. The three elements that make up the LANstar network are a PC LANlink interface card, the network device-driver software, and the *Microsoft Networks* (*MS-NET*) software. The first two elements make up the PC/LAN interface that allows programs running in the PC to send high-speed data packets to other PCs through the switch. *MS-NET* allows a PC to access disks and printers attached elsewhere on the network as if they were local to the PC. LANstar includes gateway connections for the IBM 3270 SNA, System 30 series, and X.25 networks.

PROGRAMMING The Meridian isn't normally programmed from a video terminal, though such an interface is available.

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PC-Shadow™ Workstations, shown below, even have an AT look-alike, as well as work-alike, keyboard, display, and serial port. In addition, password-protected remote access via modem can be made with either dumb terminals or PCs running our terminal emulation software.

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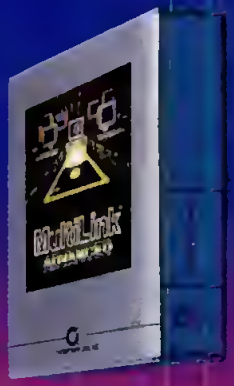

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Voice-and-Data PBX Systems: Summary of Features

(Products listed in ascending price order)

The prices given here represent the cost of a fully installed system—with all instruments, interfaces, and wiring—capable of handling 50 simultaneous voice-and-data communications sessions (100 people simultaneously transmitting both voice and data). Although all of the manufacturers put numerous caveats on these estimates, they at least represent ballpark figures.

It is valuable for voice-and-data PBX systems to have both standalone digital interfaces and interfaces integrated with telephones. The latter are good for desktop PC systems; the former for printers, modems, and other devices that don't need simultaneous voice service.

Like so many things related to voice-and-data PBX systems, the number of "ports" is defined differently by various manufacturers. For the purposes of this article, we define the number of ports to be the total number of voice connections, data connections, and outside trunk circuits. Typically, the number of trunks to outside switching services must be at least 15 percent of the number of voice instruments.

Putting voice and data on the same pair of wires can eliminate the need to rewire systems to add data service. However, if the installation has adequate wiring, this capability isn't necessary.

The asynchronous data rate is the fastest at which the switch will accept data from the serial port of a PC. While a rate of 19.2 kilobits per second is much slower than the transfer speed of media-sharing LANs, this data stream is not shared. The real throughput of a file transfer at 19.2 kilobits per second depends a great deal on the software used, but it could be as high as 1,900 characters per second. Transferring a 1,000-word document at this rate would take about 2 seconds.

Speed mediation means that the switch mediates the various speeds of connected devices. If a switch does not offer speed mediation, you'll have to use software to change the speed of the PC's RS-232C port so that you can use different devices.

Moving telephone numbers is the biggest single task handled by telephone managers. If users can move their own telephones, operations are much more efficient, saving time for both the user and the administrator.

	SX-200 Digital Mitel Inc.	Meridian SL-1S Northern Telecom Inc.	System One Shared Resource Exchange Inc.	Saturn IIE Siemens Information Systems Inc.
Typical installed price	$78,000	$85,000	$88,000	$100,000
DATA INTERFACES				
Standalone	●	●	●	●
Integrated with telephone	●	●	●	○
FEATURES				
Max. no. of ports	336	460	288	992
Voice and data using same pair of wires	●	●	○	○
Max. asynchronous data rate (kilobits/second)	19.2	19.2	28	19.2
Speed mediation	●	●	○	○
User can move telephone extension	○	●	●	●

PC—Indicates Editor's Choice ●—Yes ○—No

Instead, both users and the system administrator can use telephone instruments to pass instructions and changes to the switch. For example, if you move to a new office down the hall, you can unplug the telephone, walk to the new location, plug the phone into the wall, tap in a few keystrokes, and be connected to the switch with the same telephone number and privileges. No one else need take action to change a telephone or PC location, if both the old and new locations have the same kind of line card. The system administrator can perform more-complex tasks using a template overlay on the multibutton telephone set that normally serves as the attendant's console. This input device allows programming of privileges like unrestricted dialing, semirestricted dialing, restricted long-distance dialing, and the ability to receive only incoming calls. The sequence of commands can be completed quickly using the keys on the console, and the switch provides feedback on the console's liquid crystal display. In the event of problems, service organizations can access the switch through a remote dial-up and can run complete system diagnostics.

SMOOTH TEST To test the Meridian, we ran three simultaneous 19.2 kilobit-per-second file-transfer sessions through it. There was absolutely no speed degradation that we could see. We even tried more-subtle tests—like whistling through the phones sharing the lines to the switch to make the individual circuits busier—but the data bits passed as smoothly as if the PCs had been hooked together by straight RS-232C wiring. (We even looked in back of the switch to make sure that wasn't the case!)

As far as cost is concerned, a very small

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Stan Miastkowski
BYTE, March 1987

System Configuration

	10 MHz	8 MHz
EGA System Basic system with option, EGA board and monitor	*$1755*	*$1685*
Monographic System Basic system with option Monographic board and monitor	*$1320*	*$995*
Color System Basic system with option color board and monitor	*$1496*	*$1426*

QIC 286 System

Monitor not included.

QIC 6/8 MHz *$756*
with option *$1026*

QIC 6/8/10 MHz *$799*
with option *$1126*

Basic System: 512K expandable to 1MB, two 8-bit and six 16-bit slots, clock/calendar with battery backup, 192 watt power supply, AT™ style keyboard, complete 200 page manual.

Option:
1.2MB Floppy Drive
WD HD/Floppy Controller

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High Performance, Capacity Drive for AT

Seagate ST4038 30MB (40ms) *$589*
Seagate ST251 40MB (1/2 Ht, 40ms) *$629*
NEC D5146H 40MB (1/2 Ht, 40ms) .. *$499*
Seagate ST4096 80MB (28ms) *$1095*

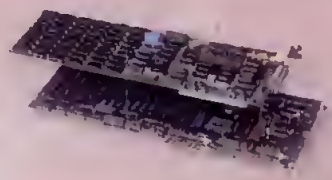
Hard Disk Kit for PC

Quality HD Kit comes with controller, cable, manual, software and mounting screws.

Seagate ST225 (1/2 Ht., 65ms) *$339*
Seagate ST238 (1/2 Ht., 65ms) *$399*
Miniscribe SCXT30 Hard Card (65ms) *$499*

Monitors

- **Monochrome** *$109*
- **Color monitor** *$295*
- **EGA monitor** *$449*
- **NEC Multisync** *$579*



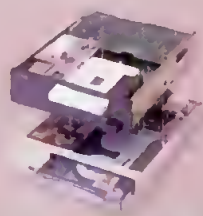
Everex Modems

- **Everex Evercom 300/1200** ..... ***CALL***
  1/2size, Hayes/Bell 103/212 compatible, Bitcom software, made in USA.
- **Everex Evercom 1200/2400** *$199*
  Same feature as above plus CCITT V.22 compatible.

- **External 300/1200** *$119*
  Fully Hayes/Bell 103A, 212A and CCITT V.22 compatible, LED status indicator.
- **External 1200/2400** *$219*
  Same features as External 300/1200.

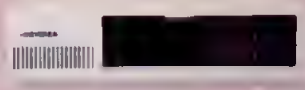
Graphics Board

- **QIC Micro EGA** *$178*
  640 x 480, 16 colors EGA mode, 720 x 348 monochrome mode, 640 x 200 16 color RGB mode, Hercules 132 column.
- **QIC Monographic** *$95*
  720 x 348, Hercules compatible, printer port.
- **QIC Monographic with 132 column** *$109*
- **Professional Graphic Adapter** *$995*
  640 x 200, 2 colors CGA mode, mono Hercules mode 720 x 348, PGA mode 640 x 480, 256 color.



Memory/Multifunction Board

- **Memory board for AT** *$155*
  0-3MB extended memory using 256K or 64K
- **AT Multifunction for AT** *$148*
  Holds up to 2MB, parallel, serial and game port, set-up software.
- **XT EMS Multifunction** *$159*
- **EMS board for XT** *$99*
- **EMS board for AT** *$139*
  Expandable up to 2MB, Lotus/Intel compatible.



Accelerator

(turbo board) *$359*
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Back-up 20MB in less than 5 minutes, Image/File-by-file back-up and restore, window driven software, made in USA.

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The System One, from Shared Resource Exchange, uses either standalone data units or data units integrated into the telephone (both shown above right) to connect PCs and other serial devices to the switch. The connection between the PC and the data unit (above left) is made over RS-232C cable, the connection between the data unit and the switch through telephone wire. Separate telephone-wire pairs are used for voice and computer data, even if the data unit is inside the phone. The wire pairs are carried inside the same telephone cable going to the telephone instrument.

PBX system is always the worst case: the more ports you have, the lower the price per port. In the case of the Meridian, a system with 32 subscriber lines and eight trunks with digital telephone sets installed will cost you $600 to $700 per line. You'll have to add $300 per port (installed) for the data module that goes into the desk set to use the system with a PC.

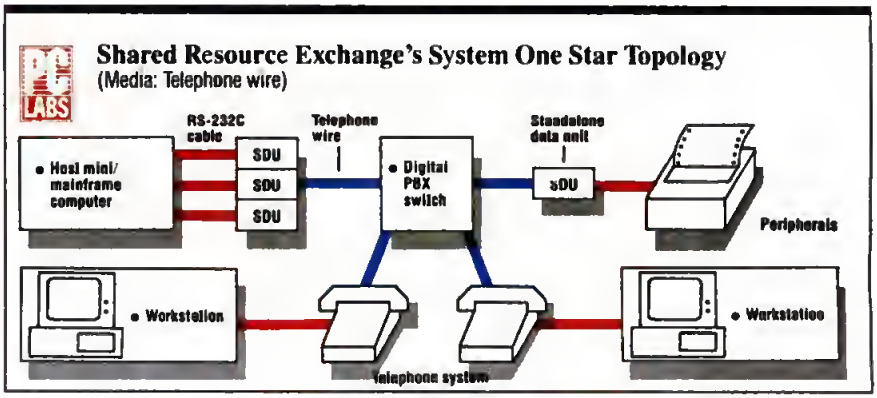
The Meridian is nice to look at and easy to use. It ranks very high as a connectivity alternative for anyone who doesn't want the programming workload of a full media-sharing LAN.

SHARED RESOURCE EXCHANGE INC.

System One

Shared Resource Exchange (SRX) is a 1983 start-up company, but it was backed by Sevin-Rosen Management, which also backed Compaq, Lotus, and Proteon—some good picks. The SRX headquarters and manufacturing facilities are in Dallas, Texas. The company's main objective is to have one product line covering the entire market for circuit-switched services of from 1 to 200 instruments. SRX achieves this with the System One PBX and its station equipment—a package with a level price per port and easy expandability. So far, the company has shipped about 500 systems.

The System One is economical in installations that range from 6 to 255 stations. Some of the other companies we visited had four products that covered this span of capability in overlapping segments; SRX offers one switch. The SRX design uses a distributed architecture that shares the processing power between a central processor and the line cards. Because of this, the system has a low initial cost, and every added line has a fixed price—about $650 to $750 per port, installed. That means that as your organization grows, the same switch will continue to give you good value.



IN A CLOSET The System One's wall-mounted cabinet measures 17 inches wide, 13 inches high, and 12 inches deep. It has no fans or other moving parts, so it can be mounted next to a desk, on a wall, or in a closet without restrictions. The basic cabinet can support a total of 48 phones and 12 trunks; the system can grow from one to a maximum of four cabinets as the need evolves. SRX offers optional battery backup for 8 hours of operation. Significantly, all telephones and data-interface devices use power transmitted over the twisted-pair wiring, so you don't lose vital telephone service because of a failure of the wall-plug transformer that powers your phone.

The heart of the System One is the same Intel 8088 used in the standard PC. This CPU functions as a call processor with a direct communications channel to the Intel 8048 single-chip controller processor (the

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We're not selling printers, but a new networking device that'll make it seem like you have an extra one. Or two or three.

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All the right connections

The Buffalo SX is an intelligent buffer, switcher and interface converter all in one. It allows several PC users to select any output device connected to the network.

There are ten ports—five parallel and five serial. Five can handle either input or output. So you have lots of options. Seven PCs sharing three peripherals. Two PCs sharing eight peripherals. Or any combination between.

But that's only the beginning. You can link more SXs together to share a set of peripherals with *any number* of PCs (of course, when you get up into the dozens, you might need another laser).

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To set up the SX, just plug it in and define the ports using the switches and software provided. Concise documentation tells you how. If you have a question, call our toll-free support line.

When someone's ready to print, they simply use the handy little menu that pops up on screen with the names you've chosen. Call your printers Martha, Chatterbox, Relic, whatever.

The SX does the rest. it handles interface conversions, making parallel and serial machines work together. Yes, it even lets IBM® and Macintosh® PCs share a laser with no fiddling. And PCs can exchange files with communications software.

Best of all, it stores print jobs in its large buffer and feeds data to the printers automatically. So people can use their computers within seconds. ("Large" means a standard 256K memory, expandable to one full megabyte.)

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Order now and receive $100 worth of productivity tools free:

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If you've tried a printer buffer, you know how limited most are. The SX is different. It's the slickest productivity booster this side of a $10,000 LAN. It's so dependable, it comes with a full one-year warranty. Plus this money-back guarantee:

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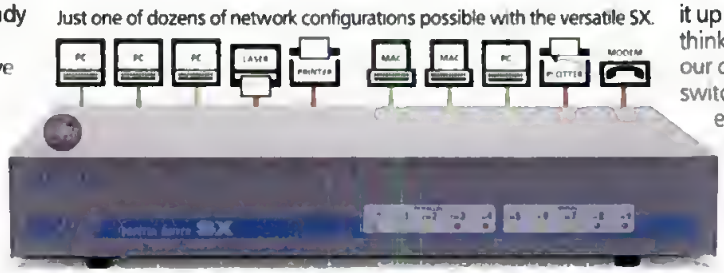

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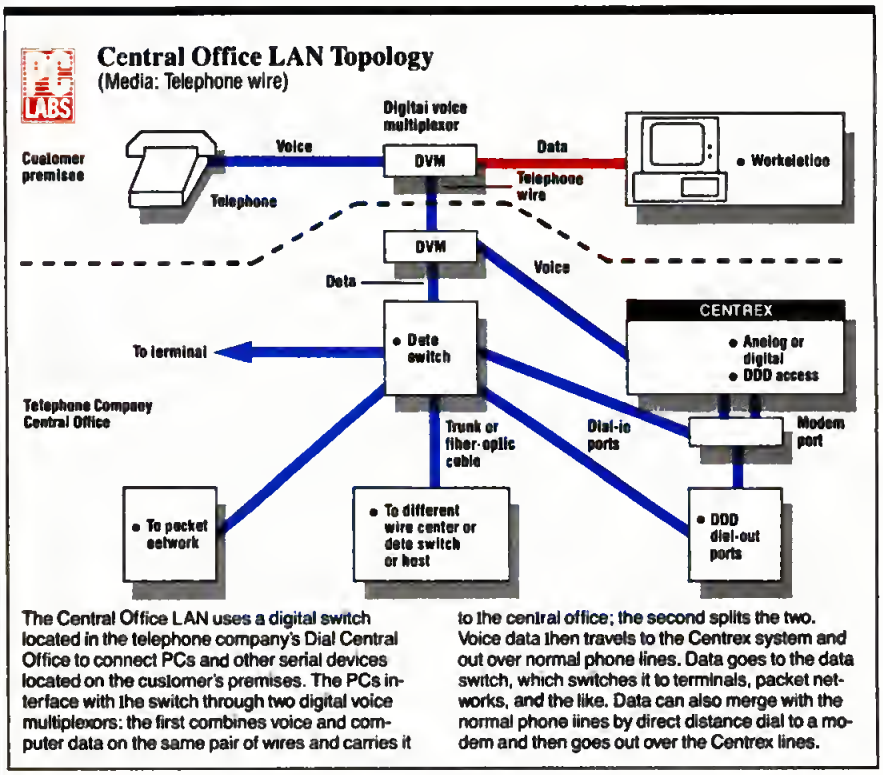
CALL THE PHONE COMPANY FOR CONNECTIVITY

Offered by many local telephone companies, CO LANs are a reliable, a distance-spanning, and an expandable way to connect large numbers of computers.

Somewhere in your community, a building houses the dial central office that provides local telephone services. All of the telephone instruments in your area are connected to this building. From it, high-capacity connections are made over microwave radio, coaxial cable, and fiber-optic links to other higher-level switching centers in the national telephone network. The heart of today's central office switch is a computer controlling a huge electronic switch system. The local telephone company already leases you some services from this system; every time you pick up a phone and call into the community, you use the central office computer.

To meet your data communications needs, the phone company often will also lease you a much bigger chunk of this system in the form of a Central Office Local Area Network (CO LAN).

Because of scheduling difficulties, we couldn't make a hands-on test of a CO LAN before publication. However, we did interview people on the CO LAN team at Bell Atlantic and visited several central offices providing this service. Here's how it works.



The Central Office LAN uses a digital switch located in the telephone company's Dial Central Office to connect PCs and other serial devices located on the customer's premises. The PCs interface with the switch through two digital voice multiplexors: the first combines voice and computer data on the same pair of wires and carries it to the central office; the second splits the two. Voice data then travels to the Centrex system and out over normal phone lines. Data goes to the data switch, which switches it to terminals, packet networks, and the like. Data can also merge with the normal phone lines by direct distance dial to a modem and then goes out over the Centrex lines.

The Central Office LAN uses a digital switch located in the telephone company's dial central office to connect PCs and other serial devices located on the customer's premises. The PCs interface to the switch through a data/voice multiplexer that combines voice and computer data on the same pair of wires going to the central office. This system is typically used in conjunction with Centrex voice services.

STRICT CODES A common central office configuration consists of an AT&T 3B20D computer driving the same company's 5ESS switch system. The 3B20D is really a general-purpose 32-bit minicomputer with 8 megabytes of memory and full duplex redundancy of critical components. The hard disk storage in these machines usually consists of three 300-megabyte systems with removable disk packs; a single 9-track tape drive is also included. The 5ESS software is based on a UNIX-derived system, Duplex Multiple Environment Real Time (DMERT), modified and expanded into

one used in Hayes modems) located on every line card. The call processor carries out the task of connecting the line cards together in response to requests from the attached instruments. The 8088 system is on a single board, and it runs a program contained in 320K bytes of EPROM. The program uses a database (consisting of details such as telephone numbers, classes of service, telephone set options, and other installation information) contained in 100K bytes of battery-backed CMOS RAM. The entire processor circuit board is much simpler and smaller than that of the IBM PC, and SRX says it's never experienced a failure in the field.

The 8048 processor that is found on each line card has 2K to 4K bytes of PROM, 128 bytes of RAM, and an I/O port that are all integrated in one chip. This chip provides the many intensive communications tasks that are associated with the port devices, including scanning the keyboard, operating the lamps and buttons on the phones, and controlling the internal telephone operation.

SRX does not use the same centralized switching matrix that is common in most PBX systems. A custom very-large-scale-integration (VLSI) matrix switches cus-

what AT&T calls Operating System Digital Switching (OSDS).

These central office systems are under constant maintenance scrutiny. If a section fails, redundant sections that are standing by come on-line automatically. The building is protected against lightning; in fact, it's probably built to stricter codes than any county inspector would require. A battery bank that can be 15 feet long, 6 feet wide, and 3 feet high provides power for the entire CO LAN system. These batteries are charged from commercial power sources, but they supply the power needed for operation and keep running through power reductions and outages.

A CO LAN system usually combines the services of the big central office computer with a specialized data switch, in many cases AT&T's Datakit Virtual Circuit Switch (VCS). The VCS moves the data between your digital devices, while the central office switch provides access to both local and long-distance connections. A CO LAN's data switch can typically provide up to 2,500 simultaneous connections (5,000 stations), with the digital devices communicating through their serial ports at speeds up to 19.2 kilobits per second. The only real technical difference between this kind of service and a PBX is that the switch is located farther away; as far as the user is concerned, however, it might just as well be on the other side of the wall.

CO LAN services are designed primarily for private networks existing within a company or organization. The nature of the service, however, allows the company or organization to be spread all over a community or campus. Connecting different floors of a building or hooking up operations in separate buildings, which can pose a significant challenge with a traditional media-sharing LAN, isn't a technical problem with a CO LAN. In some CO LAN installations, an on-site CRT and a menu-driven program allow the system administrator to make all changes and equipment moves in the network. In other installations, a call to the phone company takes care of these administrative matters. Not all companies have extended the programming power to their customers—and not all customers want it.

DIALING CENTRAL OFFICE To plug into the network, you simply need to hook the serial port on each of your PCs or other digital devices to a data/voice multiplexor, (DVM). A typical DVM might be a General DataComm DATX 2000. This box, which looks and acts like a modem, allows both voice signals and computer data to travel simultaneously on the same pair of wires. At the central office, another DVM splits the voice and computer data and then routes them appropriately. Legal restrictions often prohibit telephone companies from providing the DVM to the customer, but these companies can usually recommend where to buy one. While the prices vary according to quantity and the supplier, an average cost of $200 per station is in the ballpark.

Outside your building, the local phone company provides the link between your facility and the switch. That link can take the form of twisted-pair "outside plant" wire stretching up to about 3 miles, or microwave, coaxial, or fiber-optic services that can provide hundreds of simultaneous communications channels. These services typically operate either at 1.544 megabits or at 56 kilobits per second.

PACKAGE DEAL When you order CO LAN services, you get a complete package of services at a single price. You pay a fixed, monthly rate for these services and negotiate the terms and conditions of the contract. A CO LAN probably isn't cost-effective, however, unless you have more than 250 devices to connect. The price per port drops as you add devices, and expansion is fairly easy.

CO LANs offer a combination of reliability, distance-spanning flexibility, expansion capability, and low initial cost that is difficult to match with any other kind of connectivity alternative. What about the drawbacks? They're not available everywhere, and you don't own or directly control the resources. But despite some obstacles, the CO LAN could represent a good connectivity alternative.—**Frank J. Derfler, Jr.**

tomers on and off of a 32-megabit-per-second distributed communications data bus. The 32-megabit bus is subdivided into 512 64-kilobit channels. Of those channels, more than half (288) are dedicated to communications with the user ports, and the remainder of the bandwidth is used for service tones and control channels. The 8088 has an independent control channel to every control processor.

DATA INTERFACE To connect your PC to the switch, you'll need a data interface unit, which can be added in the field to any SRX telephone. Most PBX manufacturers offer either a digital telephone that can be upgraded or a less expensive device that can't; all SRX telephones can be upgraded. If you don't need voice capabilities near a printer or other device attached to the switch, the data interface unit can be ordered as a standalone unit that's smaller than a typical modem. The data interfaces have a wide range of options that allow control over the RS-232C signals needed by printers, modems, and other serial devices. These changes can be made from any telephone that is appropriately authorized.

The data interface unit supports dialing from a terminal by responding to signals

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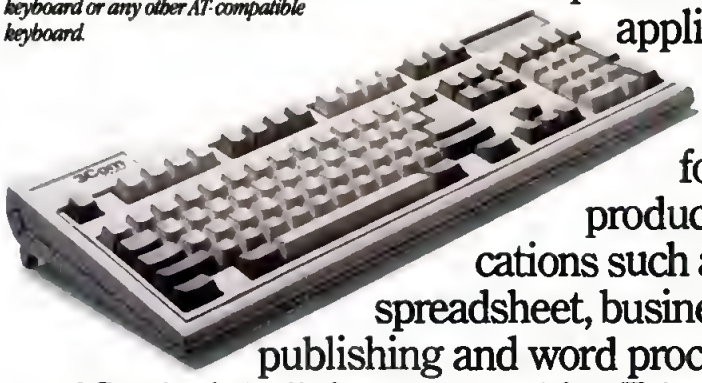

provide up to 35% more memory for your applications than adapted PCs.

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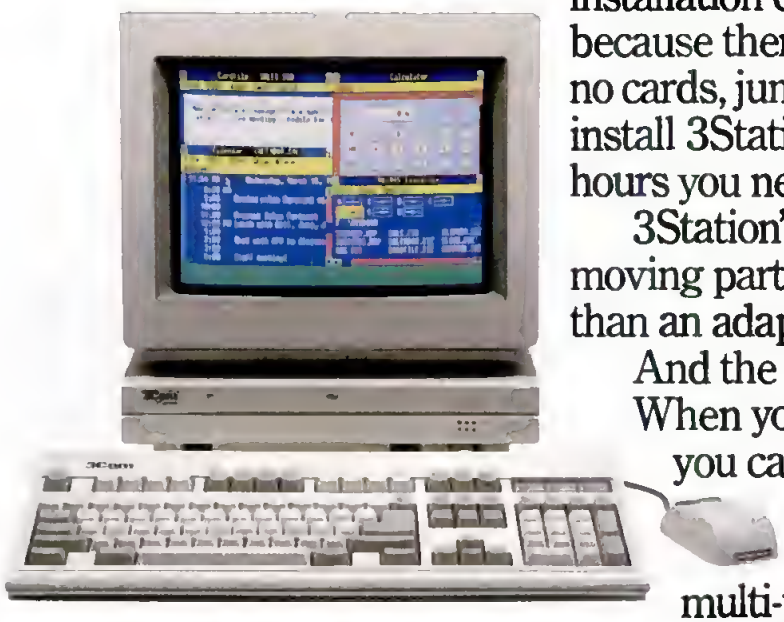

3Station is ideal for memory-intensive applications.

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PC MAGAZINE EDITORS' CHOICE

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CIRCLE 238 ON READER SERVICE CARD

from the RS-232C port and signaling the switch for attention. This means that the system can, for example, do unattended dialing in the middle of the night. When you signal the switch, the line card returns a prompt that says "Enter Number." You type in the number and get a status message back, such as "Ringing," "Busy," or "Connected." The System One does not offer automatic queuing on busy numbers. However, if the data device being called is one that has multiple RS-232C attachments, such as a minicomputer, several numbers can be assigned and the switch will hunt through the numbers to find one that is free.

After the "Connected" message is received, the processor in the SRX system drops out of the channel, and the connection between the devices becomes an open pipe. The switch will accept any packet or file-transfer protocol, but it will not mediate for different speeds between the attached devices. Once the connection is set up, dropping the RS-232C DTR line immediately hangs up the connection or the port. Alternatively, the port can be programmed to drop a connection in response to other codes, such as the +++ used by the Hayes modem.

You can also make data calls from a telephone instrument. The system does not put the data and voice on the same line, but the data line can appear on the telephone along with the voice line so that you can dial through the telephone and then transfer the call to the PC, printer, or other serial device.

■ Moving telephones, the most time-consuming job with many PBX systems, takes no time at all with the System One.

Between the data interface and the switch, a 64-kilobit-per-second data path carries the user's data. Additionally, a 16-kilobit-per-second data stream is the communications channel for the telephone's processor and the call processor. The control channel passes commands to the telephone instrument to operate its lights, liquid crystal display, and other features.

FAST PROGRAMMING You can program the System One through an RS-232C terminal or through any SRX telephone with an LCD panel. Most system administrators use the telephones, which have a two-line by 20-character display and an overlay for programming. The program in the switch takes the administrator through a menu-driven, English-language utility that allows changes in stations, lines, and many other features. The *1-2-3*–like menu allows fast selection of alternatives by the first letter of each choice.

Moving telephones and other devices, the most time-consuming job with many PBX systems, takes no time at all with the System One. Every telephone and data device made by SRX, including the data interface unit for serial devices, has a unique ten-digit serial number. The device's special privileges, class of service, speed-calling numbers, arrangement of feature buttons, extension numbers, and other attributes are all associated with that serial number. To move a phone or PC, you sim-

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

System One
Shared Resource Exchange Inc.
t5926 Midway Rd.
Dallas, TX 75244
(214) 788-8700
Typical Installed Price: $88,000 for system able to handle 50 simultaneous voice and data exchanges plus 15 voice trunks (t00 users, each simultaneously transmitting voice and data to one another). Price includes wiring, training, instruments, attendant console, and full installation.
Requires: RS-232C serial port.
In Short: A voice-and-data PBX system with a low initial cost and a fixed expansion price per port. Phones and data interface devices are powered through the phone lines, providing extra protection during power failures. Also, a system of ten-digit device serial numbers makes the System One particularly easy to program.

CIRCLE 657 ON READER SERVICE CARD

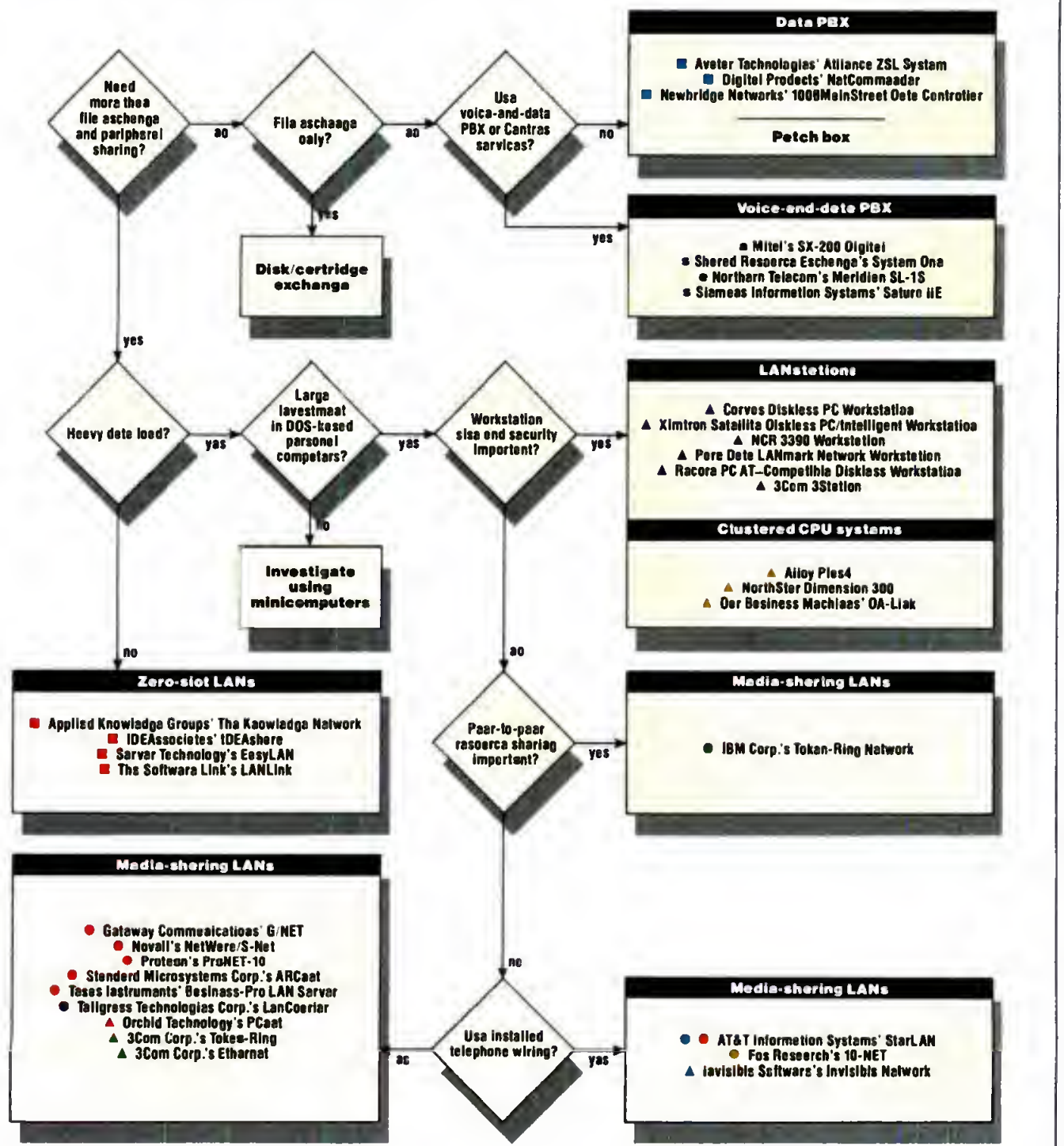
The Connectivity Decision Guide

This chart is designed to help you select from among the many information-transfer and resource-sharing alternatives. As you can see on the chart, if all you really need to do is exchange files or share printers, then you should consider devices such as PBXs and patch boxes. If your organization hes not already invested heavily in PCs or DOS programs, then a minicomputer might meet your needs more economically. But if you went many users to share date files simultaneously under DOS, a LAN may be the best alternative. Once you've decided on a LAN, the need for station-to-station resource sharing and other factors will influence your network purchasing decision.

Because manufacturers include many different features in their networks, some products will not fit neatly into one decision box in this guide. You'll also find that the lack of differentiation between LANs is becoming as large a problem in the LAN industry as the lack of standards was 2 years ago. But overlapping features and technical similarity between networks are good news for potential buyers. They will let you concentrate on more-traditional factors such as dealer support and price instead of on more-technical considerations.

Reviews originally appeared in *PC Magazine:*

- Volume 5 Number 21
- Volume 5 Number 22
- Volume 6 Number 1
- Volume 6 Number 2
- Volume 6 Number 3
- Volume 6 Number 4
- Volume 6 Number 6
- Volume 6 Number 7
- Volume 6 Number 10
- Volume 6 Number 11
- Volume 6 Number 12
- Volume 6 Number 13


Need more than file exchange and peripheral sharing?
no
File exchange only?
no
Use voice-and-data PBX or Centrex services?
no
Data PBX
Avaya Technologies' Alliance ZSL System
Digital Products' NetCommander
Newbridge Networks' 100BaseStreet Data Controller
Patch box
yes
Voice-and-data PBX
Mitel's SX-200 Digital
Shared Resource Exchange's System One
Northern Telecom's Meridian SL-1S
Siemens Information Systems' Saturn IIE
yes
Disk/cartridge exchange
yes
Heavy data load?
yes
Large investment in DOS-based personal computers?
yes
Workstation size and security important?
yes
LANstations
Corvus Diskless PC Workstation
Ximtron Satellite Diskless PC/Intelligent Workstation
NCR 3390 Workstation
Pure Data LANmark Network Workstation
Racore PC AT–Compatible Diskless Workstation
3Com 3Station
Clustered CPU systems
Alloy Ples4
NorthStar Dimension 300
Our Business Machines' OA-Link
no
Investigate using minicomputers
no
Zero-slot LANs
Applied Knowledge Groups' The Knowledge Network
IDEAssociates' IDEAshare
Sarver Technology's EasyLAN
The Software Link's LANLink
no
Peer-to-peer resource sharing important?
yes
Media-sharing LANs
IBM Corp.'s Token-Ring Network
Media-sharing LANs
Gateway Communications' G/NET
Novell's NetWare/S-Net
Proteon's ProNET-10
Standard Microsystems Corp.'s ARCnet
Texas Instruments' Business-Pro LAN Server
Tallgrass Technologies Corp.'s LanCourier
Orchid Technology's PCnet
3Com Corp.'s Token-Ring
3Com Corp.'s Ethernet
no
Use installed telephone wiring?
yes
Media-sharing LANs
AT&T Information Systems' StarLAN
Fox Research's 10-NET
Invisible Software's Invisible Network

A lot of computer for your money

Bentley-286

The Bentley-286/10 Personal computer features an Intel 80286 processor running at a blazing 10MHz, a Phoenix BIOS for insured compatibility, 512KB RAM expandable to 1024KB, keyboard, dual diskette drive/hard disk controller, and a 1.2MB diskette drive.

Base system $995

The Bentley-286/8 Has the same standard features as the Bentley-286/10, with 8 MHz, 0 wait state processing power.

Base system $979

Monitor not included

Bentley-286/10 42MB hard disk model
A winning combination: the Bentley-286/10 plus a 42MB MiniScribe hard disk drive. The MiniScribe drive features a 28ms average access time and automatic head parking on power down. Partitioning software is included so you can take full advantage of the increased storage capacity.

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Bentley-286/10 20MB hard disk model
A new addition to the Bentley family of computers: the Bentley-286/10 plus a 20MB, 65ms-access-time hard disk drive.

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Monographics Card- High resolution, monochrome graphics card with parallel port. Use with a monochrome monitor for high-quality monographics display

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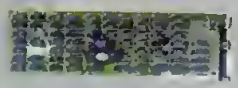

ColorCard- High-resolution color graphics card works in color or composite mode. Use with a color graphics monitor

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Modems- All Bentley modems are compatible with all popular communication standards and have auto answer, auto redial, and auto voice/data switching. External modems include LED status indicators and require modem cable for hookup

300/1200 Baud Internal Modem ... $99

300/1200/2400 Baud Internal Modem .. $239

300/1200 Baud External Modem.. $139

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Monochrome Monitor- Flat screen Samsung monitor with tilt and swivel base and twelve-inch screen. Use with the monographics card or monochrome card for easy-to-read display

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NEC MultiSync- The elite monitor. Adjusts to any horizontal frequency between 15.5KHz and 25KHz. Resolution up to 800 x 560, and supports both analog and TTL inputs. Thirteen-inch screen

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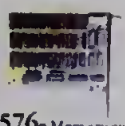

MEM-576- Memory expansion card that fits in a short slot and supports either 64K or 256K chips. Comes with 0K, expandable to 192KB, 284KB, or 576KB

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EMS- Expanded Memory specification card compatible with the Lotus/Intel memory specification. Comes with 0K, expandble to 2MB. Includes utility software

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128K chips	$49
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256K chips (120ns)	$35

Coprocessors-

8087-3	$129
8087-2	$159
80287	$219
80287-8	$269

AT I/O- Serial port and parallel port.

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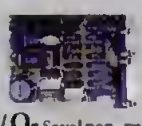

PC I/O- Serial port, parallel port, game port, and clock-calendar with battery back-up

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20MB Bentley Turbo 10
The high-speed Bentley Turbo 10, fully equipped with a MiniScribe 20MB fixed disk drive.

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Bentley Model "T" Intel 8088 processing power in an IBM® XT compatible — runs at a keyboard-selectable 4.77 MHz or 8 MHz processing speed, a 70% increase from the original IBM® PC. Standard features include 256KB of random-access-memory expandable to 640KB, keyboard, diskette drive controller card, and 360KB diskette drive.

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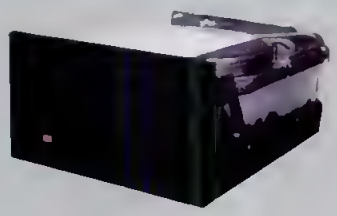

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Both drives feature an average access time of 28 milliseconds. The drives' positioning systems use a rugged linear voice coil actuator that eliminates head skew problems common with other positioning mechanisms. Microprocessor-aided control provides fast, accurate head positioning. In addition, superior head/disk tracking is achieved through the use of Whitney technology head sliders and flexures. With MiniScribe's fail-safe actuator lock, the head positioner is retracted and locked at power-down, eliminating data zone contact. Partitioning software is included so you can take advantage of the full storage capacity.

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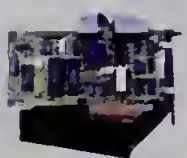
Tape Backups- Avoid disk swapping: streaming tape for your IBM® AT, PC, or compatible

Stream-20 by Tallgrass For the PC **$389**
Stream-60 by Wangtek For the AT **$757**



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PC MAGAZINE EDITOR'S CHOICE

- **Meridian SL-1S**
- **System One**

These systems are all so full of features that no single one stands clearly above the others for all applications. If you are planning a system that will start small and grow, then the Shared Resource Exchange's System One is the clear winner. Its engineering and styling are both outstanding, and it demands little in terms of space, programming, or maintenance.

Northern Telecom's Meridian SL-1S is the choice for those who have complex corporate data communications needs. The system provides all types of corporate connectivity, from small switches to private packet-switching networks suitable for 500 or more terminals. It even hooks into Northern Telecom's own media-sharing LAN.

ply unplug it from its old location and plug it into the new one. The switch's program doesn't have to be told anything; it finds the instrument automatically. The device operates in the new location just the same as in the old.

SRX calls the phones for the System One the Model 100, 200, and 400. The main difference between these phones is in how many buttons they have and whether they have a speakerphone or display. Functionally, they all have the same capabilities, but some phones offer features through special function keys. Phones with fewer keys can dial special function codes if more features are needed. On all of the phones, the ringer, speaker, and earpiece can be set to individual volume levels; ringers can also be set to one of eight different frequencies so that several phones in the same room can each have a different ring.

CLEAN LINK We continuously pumped data from multiple PCs through the System One and could find no speed difference between sending data through the switch and using a direct connection through an RS-232C link. Additionally, unlike all of the other switches we tested, the System One can connect serial devices like PCs at speeds faster than 19.2 kilobits per second. If your communications software will operate your PC at 28 kilobits per second, you can effectively use this speed with the System One switch.

Good pricing, flexibility, and excellent performance—we didn't find anything not to like about the System One.

SIEMENS INFORMATION SYSTEMS INC.

Saturn IIE

Siemens is a very large multinational corporation with roots in West Germany; the home of Siemens Information Systems, however, lies just down the road from the IBM PC's now-vacant birthplace in Boca Raton, Florida. The company's line of telephone switches and equipment, manufactured in Cherry Hill, New Jersey, is exported around the world. Five field offices provide support and maintenance in the United States. Like most big PBX manufacturers, Siemens has a broad line of switches that can meet any communications need, from small work groups to large communities or campuses.

We reviewed the Saturn IIE, a system with a variety of capabilities tailored to a good-sized office or organization. The standard cabinet—42 inches wide, 27 inches deep, and about 36 inches high—can handle 224 to 480 service ports, depending on how they are configured. An expansion cabinet makes the system 70 inches high and gives it enough line-card capacity to service up to 992 ports. The system uses 1.5 megabytes of 8-bit memory and two 5¼-inch high-density disk drives. Its power supply can handle brownout conditions, and power-outage options are available.

At the heart of the Saturn IIE switch is a device familiar to readers of *PC Magazine*: the Intel 80186 processor—actually, three of them. This computer is hardly an MS-DOS system internally, however. The first 80186 runs a program that takes care of real-time communications, including managing stations requesting service and dialing. The program recognizes stations, verifies their privileges, and takes their incoming digits. If a station wants to place a call, the digit string is passed to the second processor and its programs, which set up and complete the call. The second processor determines what line the called party is attached to and what resources of the switch to allocate to the call. The third 80186 is the programming and reporting interface; it handles the four RS-232C I/O ports that drive printers, the remote administrative modem, and ASCII or VT-220 terminals. These are used to program and control the switch.

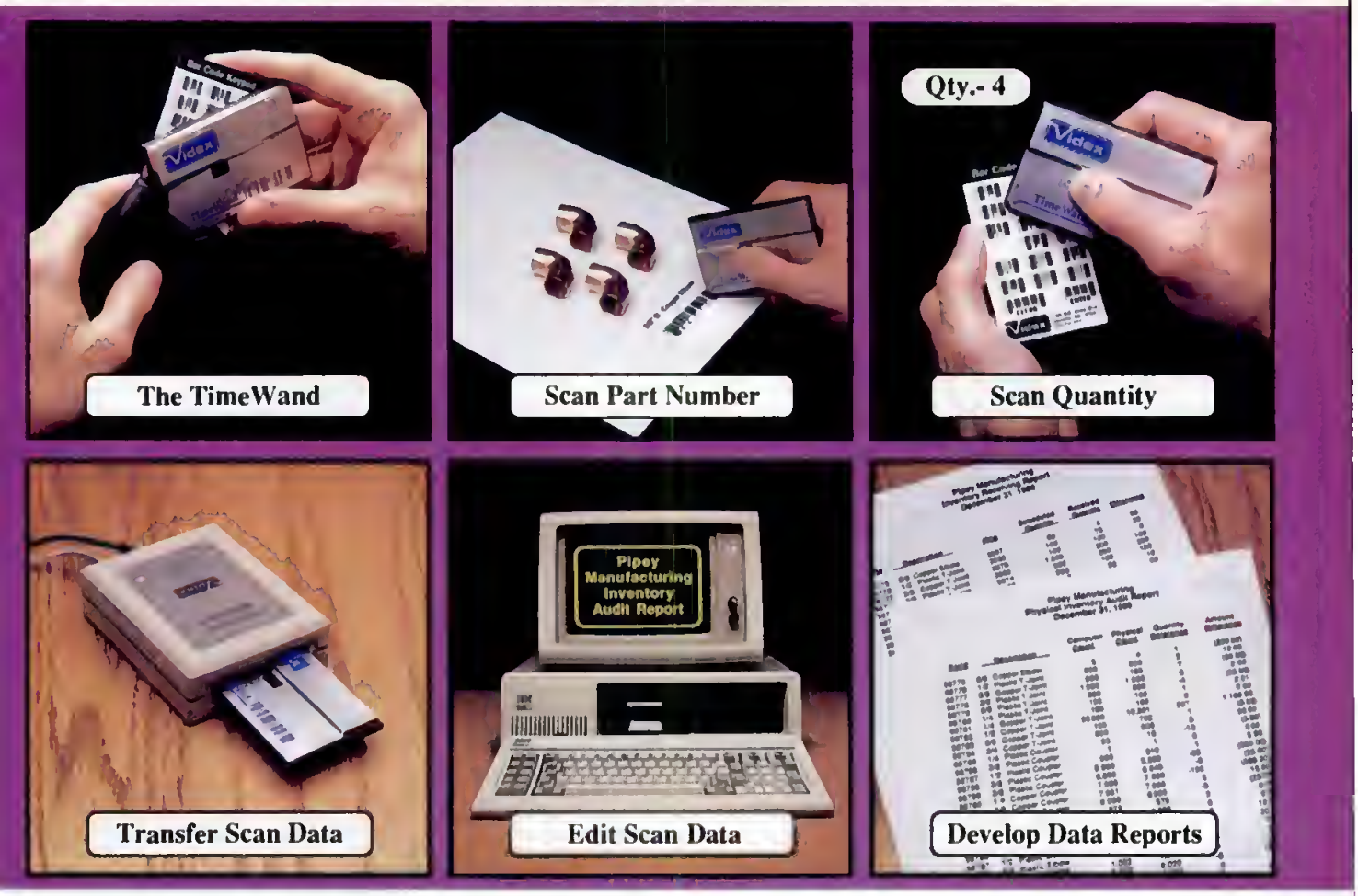
DATA CALLS Unlike Northern Telecom's Meridian SL-1S, the Saturn line does not include digital-device interfaces in the telephone instruments themselves. Instead, each digital device is attached to a box (which looks very much like a modem) called a data communications interface (DCI). The DCI is programmed by the switch to give certain types of responses and service to its attached digital device. DCIs can have various functions. Some can control modems in a modem pool; they pass data through the pin-20 control lines of the RS-232C connector, a

PC MAGAZINE FACT FILE

Saturn IIE
Siemens Information Systems Inc.
5500 Broken Sound Blvd.
Boca Raton, FL 33431
(305) 994-8800
Typical Installed Price: $100,000 for system able to handle 50 simultaneous voice and data exchanges plus 15 voice trunks (100 users, each simultaneously transmitting voice and data to one another). Price includes data interface device and attendant console; wiring, training, instruments, and full installation may also be included depending on customer requirements.
Requires: RS-232C serial port.
In Short: A flexible scheme for networking many kinds of digital devices. The company also offers a customized version of Compaq's TelePlus telephone/data terminal. The Saturn IIE system requires that you plug your PC into a separate data communications interface, and it sends voice and data on separate twisted-pair wires.

CIRCLE 656 ON READER SERVICE CARD

TimeWand™ - Gathering Information



Bar Codes, Computing, and the TimeWand... a Closer Look.

"A successful business runs on accurate, timely information." An obvious statement perhaps, but one that every personal computer user must keep in mind. In order to get the reports we require, we must ensure that the information on which we base our decisions is as up-to-date as possible. This is where a bar code reading system such as the TimeWand can be used to improve efficiency in the office or workshop. The TimeWand provides a convenient way to ensure that your computer has all the facts, all the time.

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TimeWand Communication Software (IBM) - $299

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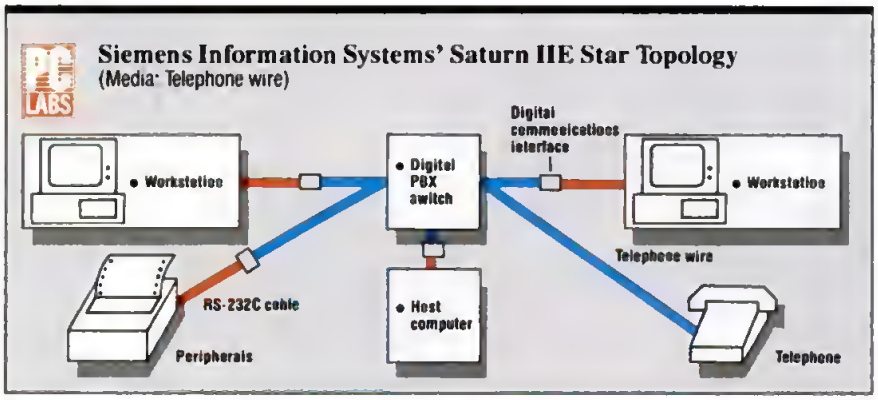
CIRCLE 230 ON READER SERVICE CARD

feature that could be attractive if your modems require this interface. Other DCIs can be programmed from the supervisor's console to automatically adjust to the bit-per-second rate used by the attached unit. A DCI connects to the switch through a single twisted-pair wire, which can run up to 4,000 feet. It communicates asynchronously with the attached device at 19.2 kilobits per second.

You can originate a computer-data call on the Saturn switch in one of two ways. The first is to use a phone attached to the DCI and, after the connection is made, press Data Call on the DCI. Or you can make a call from the computer by pressing the Data Call switch on the DCI and responding to the prompt "Enter Destination" that appears on the screen. Then you key in the four-digit extension number you want to call and wait for the switch to respond with "Valid Entry." If the system you called is available, the switch will send you the message "Answered"; if not, it automatically puts your call on a queue and tells you the number of callers ahead of you. The Saturn system requires that someone physically press the Data-Call switch to originate a call. That means that the system cannot be used for completely unattended outward dialing, though it can be used for unattended answering.

An interesting feature of the system is its ability to set up a "warm line." A "hotline," of course, is one that automatically connects to a specified number whenever the handset goes off the hook. The Saturn's warm line waits 30 seconds for you to enter a choice; if you don't, it automatically becomes a hotline and connects you. This can be useful in situations in which you almost always call a single host computer or electronic mail system.



Siemens Information Systems' Saturn IIE always uses a dedicated digital communications interface (DCI) between the PC, printer, modem, or other device and the switch. The connection between the digital device and the DCI is made through RS-232C cable. The connection between the DCI and the switch is made over telephone wire. Separate wire pairs are used for voice and computer data.

CUSTOMIZED COMPAQS Siemens has a nice line of telephone sets, some of which reflect European styling. It also markets a customized version of Compaq's TelePlus integrated data/voice terminal. The TelePlus gives access to four phone lines and has a Rolodex, telephone book, and other productivity tools combined into a single terminal with a Compaq computer. It also offers a completely digital connection with the Saturn switch. The TelePlus includes an e-mail host package that operates perfectly through switched systems. Calls are made and received in the background mode, and you can create a distribution list able to make multiple phone calls and distribute letters in the background mode.

To set up and make changes to the Saturn system, you use a dumb terminal or a PC running a communications program that makes it look like a DEC VT-220 terminal. All administrative functions, such as moving instruments and changing privileges, are handled through a menu structure; a similar menu is used to set up the switch's computer data interfaces. The menu is easy to use and includes the option of entering commands directly, using plaintext words such as Add, Move, and Change. Context-sensitive help is also available.

OPEN PIPE If you are going to use the Saturn to pass data, you have to set the DCIs to some initial operating configura-

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■ PBX SYSTEMS

■ The Saturn IIE system is rock solid and full of features and provides a flexible interface for many digital devices, such as modems and printers.

tion. If you're unfamiliar with the RS-232C system (and many telephone administrators are), this could be a troublesome task. Once you take care of the word length, parity, and DTE/DCE options, however, the system handles your data as advertised. Our file-transfer tests showed no speed reduction going through the DCI and the switch compared with a direct RS-232C connection; we also could detect no ill effects when we put an extra load on the switch. The DCI connection is essentially an open pipe: once you've completed the call, you can send any type of protocol or data block through the switch.

The price of a Saturn system will vary with the number of ports you plan to set up. The DCI connection for PC and digital-device ports can add $400 to $700 per port (depending on its specific capabilities and installation) to the cost of the basic telephone system.

The Saturn system is rock solid and full of features. On the downside, however, the separate DCI doesn't integrate the data device, the switch, and the telephone as smoothly as do systems that connect the digital device through the telephone itself. That voice and data signals are not combined in the same wire pair could be a negative factor, but only if the existing wiring is already heavily loaded with telephone instruments. On the positive side, the DCI provides a flexible interface for many kinds of digital devices, such as modems and printers, that can be shared through the switch. PC

Frank J. Derfler, Jr., is a contributing editor of PC Magazine.

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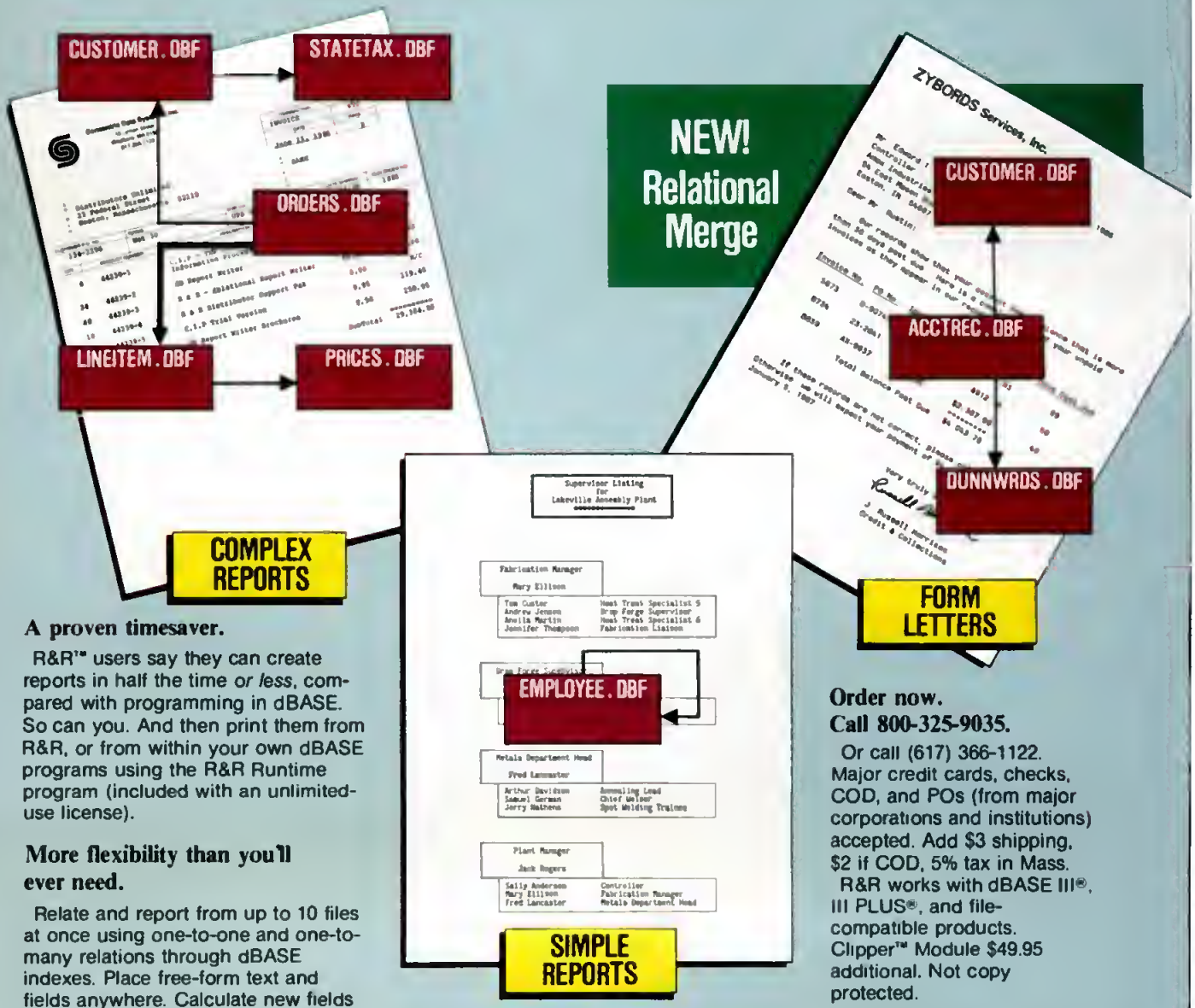

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CIRCLE 315 ON READER SERVICE CARD

ROBIN RASKIN AND M. DAVID STONE

PICTURE DATABASES: COMING INTO FOCUS

As exciting as they are for extending database applications, picture database systems don't simply add an additional, pictorial field to your familiar "field-and-record" database. They also add expense and a whole new array of technical difficulties for the end user. Of the six systems we review, only one is suitable for off-the-shelf use.

On a mission to rescue sunken treasures from the wreck of a Spanish galleon, *VisionBase*, a picture database, is busily storing images of lost treasure and maps of coordinate points. The backbone of Lifenet, a nationwide archive of photos of missing children, is another picture database, the Color PhotoBase System.

In art and photo libraries, these picture databases and others, such as Video Image File, Instant Image Talk Workstation System, PicturePower Color System, and PicturePro-DB, are archiving voluminous collections. Among other things, they're helping police investigators sift through mug shots, house hunters preview images of their dream homes, and security guards use database photos of employees as passwords. Whether you create product catalogs, manage a parts inventory, or run a casting agency, if a true-to-life picture helps tell the story, the picture database is your answer. Here we look at this hot new product category and review the six picture databases mentioned above.

A picture database is a hardware/software hybrid that incorporates a new kind of field—the picture field—into the familiar "field and record" database. To create the picture field, you can start with any analog video source (a video camera, VCR, videodisk, or any broadcast-quality source). Then, using traditional database criteria, you can store the picture, incorpo-

Picture Databases: Summary of Features

(Products listed in alphabetical order)

HARDWARE FEATURES	Color Photo-Base System	Instant Image Talk Workstation System	PicturePower Color System	PicturePro-DB	Video Image File	VisionBase
INPUT OEVICE						
B&W camera	○	●	●	●	●	●
RGB camera	●	●	●	●	○	●
Composite color camera	○	●	●	●	●	●
VCR	○	●	●	●	●	●
Scanner	○	●	●	●	●	●
Video compact diac player	○	●	●	●	●	●
CAPTURE BOARO						
AT&T Targa 16	○	N A	●	○	N/A	●
AT&T Targa M8	○	N/A	● (B&W version)	●	N/A	○
AT&T Image Cepture Board	○	N A	○	○	N/A	●
PC-Eye	●	N A	● (B&W version)	○	N/A	○
OISPLAY MONITORS SUPPORTEO						
B&W	○	●	●	●	●	●
Anelog RGB	●	○	●	○	○	●
Composite color	○	●	●	●	●	●
OUTPUT DEVICES SUPPORTED						
Grephics printers	● (Epson FX compatible)	○	○	○	○	○
Film recorders	●	●	●	●	●	●
Video printers	●	●	●	●	●	●
COLOR AND RESOLUTION						
No. of colors	256	NTSC Standard	32,000	None (monochrome)	None (monochrome)	32,000
Full-screen resolution	320 × 200	300 lines (analog)	512 × 400 (doesn't use full screen)	512 × 400 (doesn't use full screen)	280 lines (analog)	512 × 400
Quarter-screen resolution	160 × 100	None	256 × 200	256 × 200	None	None

rate it into a database, and later recall it.

While the mission of the picture database is singular, the road to creating a picture database is full of forks and detours. No matter which route you take, plan to spend some money on the way. The systems we tested run from hefty ($3,000 to $4,500 for modest configurations) to super-hefty ($16,000 for the videodisk recorder/player–based Instant Image Talk Workstation System).

PICTURE NOT-SO-PERFECT Picture database systems require you to do a great deal of installing, configuring, and troubleshooting—then do it all over again. While the thought of incorporating picture images in a database may seem like a journey's end, this first crop of picture databases could make anyone but the most knowledgeable end user feel as if he has arrived at an impasse. With the exception of the PicturePower Color System, these products are not yet suitable right off the shelf for the end user. Most require a professional applications developer to take command.

What's holding up the picture database show? Video has been around for a long time, but the hookup between the analog video and the digital computer is still immature. No matter how you attack the problem, the key process in these systems—video capture and display—is hardware intensive. Worse, so far the process has not been standardized to any extent. The current crop of video boards and their accompanying software offers tremendous diversity in function and capability. The systems that require capture-and-display boards must contend with a panoply of PC compatibility issues. Others bypass the boards by offering a video input to external storage, then use the PC to manage image search and retrieval; none of these systems have been standardized.

The only current standard in the video-to-PC-connection is a lack of standardization: in performance and operation from one graphics adapter to another, from one monitor to another, and from one storage device to another. In short, installing and using a picture database is like striving for consensus at the Tower of Babel.

SOFTWARE FEATURES	Color Photo-Base System	Instant Image Talk Workstation System	PC PicturePower Color System	PicturePro-DB	Video Image File	VisionBase
Image capture software used	*Color PhotoBase*	*Instant Image Talk*	*PicturePower*	*PicturePro-DB, Image-Pro*	User written (demo software supplied)	*VisionBase*
Image manipulation software used	None	None	*PicturePower*	*Image-Pro*	None	None
IMAGES						
Max. no. of pictures in single record	1	Unlimited	64	64	2,460	6
Max. no. of pictures per database	46,000	24,000 per videodisk	Unlimited	Unlimited	2,460 per unit	Unlimited
Image on different drive from text data	●	○	●	●	○	●
Image shown on same screen as text data	●	○	●	●	○	○
User-defined image placement	○	○	●	●	○	○
User-defined screen image size	○	○	●	●	○	○
DATABASE CAPABILITIES						
Built-in database	None	Associative	Flat file	Flat file	Flat file	Uses compiled program written in *dBASE III*
Works with *dBASE III*	●	○ (but customizable)	○	○	●	● (using *VisionBase/Tools*)
Works with *dBASE III Plus*	○	○ (but customizable)	●	●	●	● (using *VisionBase/Tools*)
Works with other programs	●	○ (but customizable)	○	○	●	● (using *VisionBase/Tools*)
Can incorporate images into existing database file	●	○	●	●	●	● (using *VisionBase/Tools*)

PC—Indicates Editor's Choice ●—Yes ○—No N/A—Not applicable the product doesn't use a capture board, instead, the images are stored in an RS-232 device

HYBRIDS Hybrid systems take existing technologies and link them together to create a new technology. Picture database systems definitely fit the hybrid bill. Each of the systems we reviewed is a unique jigsaw puzzle combining capture-and-display boards; various capture, display, and graphics software; customized and off-the-shelf database software; a potpourri of cabling; a bevy of monitors; video equipment; and even an occasional hard-copy output device. Along with the parts comes a mob of installation procedures: jumpers to jump, DIP switches to switch, and cables to cable.

The sheer number of components spawns a host of picture database options. Some of the systems use black-and-white video images, some are color based. Some use the PC disk drive or WORM (write-once, read-mostly) drive for image storage; others use an analog videodisk. Some incorporate multiple images within a single database record, while others are restricted to only one image per record. Some operate in resident memory to capture an image, some are DOS-executable files, and some consist of standalone applications software. Others include graphics software to manipulate the image once it has been captured. Some have their own built-in flat-file databases; still others offer rather tenuous links to the more-powerful established database applications. Resolution and color displays vary from one system to another.

Amid the chaos, market leaders are emerging. Chorus Data Systems, maker of *Color PhotoBase* software (the uncontested old grandad of picture databases) pioneered an exciting technology before the hardware was easily available. And PictureWare's attractive packaging, simple installation, and all-inclusive product, the PicturePower Color System, are high on the end user's wish list. However, even the young upstarts are developing some new twists: for example, *VisionBase* serves the end user by offering its technology in ready-to-use vertical applications and the Instant Image Talk Workstation System uses videodisk storage technology—an exciting, but almost prohibitively expensive, approach.

LONG JOURNEY Since getting from external image to picture database can be a long, arduous, and expensive journey, you'll want to be prepared. Here's the road you'll want to follow and what you'll need along the way:

Input. An image can be a flat drawing, a three-dimensional object, or a live subject. You capture the image by using a camera, VCR, or other video input device. If you use a camera, you'll most likely mount it on a tripod and aim it at a live subject or mount it on a copy stand. The copy stand holds the camera in a vertical position and often contains lights and reflectors to illuminate the image. Some of the systems reviewed here include copy stands and video camera equipment; others do not. Once the camera is secure, you focus, adjust the settings, and control the snapshot through the PC capture software with a "hot key" or command menu selection.

Picture database systems are available to handle both black-and-white and color video. Color cameras often require an RGB adapter. The adapter splits the video signal into its three primary colors, offering a cleaner signal for digitization. The video signal can also come from a VCR or a broadcast TV signal. The captured shot is grabbed from the video signal, either a line at a time or a frame at a time.

Capture. The video capture board is installed in the PC. At the board the analog video signal is digitized so that the PC's "on-off" frame of reference can understand it. Chorus Data Systems' PC-Eye board, the precursor to its Color Photo-Base System, was one of the original low-cost video capture boards, selling for under $500. But it requires a second board, the Quadram Palette Master, to display the image. When compared with boards such as the AT&T Targa, the PC-Eye has serious resolution and color limitations. Also, because it grabs a line of data at a time as opposed to a complete frame, image capture takes several seconds. These seconds feel like an eternity when contrasted with the AT&T Targa 16 board's 1/30 second (real time) image capture.

Targa Boards. AT&T's amazing Targa (Truevision Advanced Raster Graphics Adapter) series of boards, of which the Targa 16 is the latest, eliminates many of these limitations. The Targa series was introduced 2½ years ago. Since then, as developers began to realize the commercial potential of the boards' high-resolution, full-color, high-speed capabilities, Targa boards have been showing up at the center of a number of applications such as picture databases, image-processing devices, and professional paint systems.

One or another of the Targa series is the backbone for a number of picture database systems. The Targa M8 is a black-and-white-based board; offering 256 levels of gray, it produces results that look very much like black-and-white photos. The top-of-the-line Targa 16, which takes a whopping 16 bits per pixel, can display 32,000 colors simultaneously. It has a resolution of 1,024 by 1,024 pixels, and the potential to create 16.7 million colors. The image it displays is about as close to true color as you'd ever need.

But the great news is that the Targa series combines image capture and display on a single board. Unlike the PC-Eye board, which uses a line-grabbing technique for digitizing the video signal, the Targa grabs an entire frame of data at once, making real-time capture a reality. However, capture boards like the PC-Eye still have a place in the market when high-volume, recognition-quality images are acceptable, because their images take up much less disk space than the Targa-based images. But for true-to-life high-quality images, the Targa board is unbeatable.

Each picture database will require a unique combination of hardware and software. No system is typical. We found the PicturePower Color System easy, as these things go, to install. For $6,230 PictureWare will provide (clockwise) a Sony CPD-1201 analog monitor, image-capture and database software, cabling, an AT&T Targa 16 board, and a JVC RGB camera.

Photograph: Thom O'Connor

Display. The image-capture board is connected to the video camera. The combination capture-and-display boards receive input from the video camera and send output to the monitor(s). The camera's analog signal is converted to digital, then processed and reconverted to analog, ready for display on an analog monitor. Since an analog monitor can display continuous tones, it is much better suited to displaying true-to-life colors and images than a standard PC monitor is. An RGB analog monitor can display an almost infinite variety of colors and show subtle differences in shading. Analog monitors produce an image superior to any of those found in the traditional CGA- or EGA-driven monitors. Each of these systems allows for various types of monitor combinations, but the most flexible systems allow for an analog monitor and a standard PC monitor hookup.

Image Capture and Display Software. The controlling force behind the board's capture-and-display capabilities is software. Software controls the capture, processing, storage, and display of an im-

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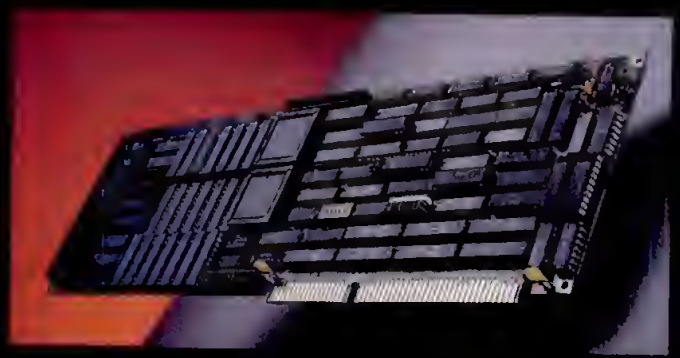

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Performance Tests: Picture Databases

(Times given in seconds)

To test the performance of these picture databases, we took a full-screen image and timed its storage and retrieval procedures. We then went to the directory to determine the size of the image and extrepolated from there the number of images that would fit into 10 megabytes. We repeated the process for a quarter-screen image.

In general, picture databases make a trade-off between picture quality and file size. As a result, while Color PhotoBase System displays only 256 colors at a resolution of 320 by 200, it can store a full-screen image in 53K. PicturePower Color System, on the other hand, which depends on AT&T's Targe 16 board, offers 32,000 colors at a resolution of 512 by 400, but each full-screen file is 313K.

The Video Image File and Instant Image Talk Workstation System are notable for their fast image storage and retrieval times and the large number of pictures they can store. All result from the two systems' analog storage techniques.

FULL-SCREEN IMAGE

	Storage time (seconds)	Retrieval time (seconds)	Picture file size (K bytes)	No. of pictures per 10 Mbytes
Color PhotoBase System	10.0	5.0	53	188
PicturePower Color System	9.5	11.8	313	32
PicturePro-DB	9.0	8.0	190	52
VisionBase	4.5	3.8	410	24
Video Image File	<0.5	<0.5	Images stored in separate unit	2,460 pictures per unit
Instant Image Talk Workstation System	<0.5	<0.5	Images stored in separate unit	24,000 pictures per videodisk

QUARTER-SCREEN IMAGE*

	Storage time (seconds)	Retrieval time (seconds)	Picture file size (K bytes)	No. of pictures per 10 Mbytes
Color PhotoBase System	3.0	2.0	13	769
PicturePower Color System	4.3	3.9	84	119
PicturePro-DB	5.0	2.9	65	153

*VisionBase, Video Image File, and Instant Image Talk Workstation System do not generate quarter-screen images

age. Speedy processing is required. Most of the systems' software is a video equivalent of WYSIWYG: WYDIWYG, or what you digitize is what you get. Some of the software packages fiddle with the color saturations to enhance the image.

The amount of postprocessing software that picture database systems include varies from package to package. Some packages allow you to manage the screen image size and position the image for display. For example, a database might use a quarter-screen image with the picture in the upper-right-hand corner.

In some cases, you can also manipulate and modify the captured image with graphics software. *PicturePro-DB* is designed to work with Media Cybernetics' *Image-Pro*, which includes *Dr. Halo* as the drawing component of the program. *VisionBase* can use AT&T's *TIPS* (Truevision Image Processing Software). The PicturePower Color System offers the most extensive built-in postprocessing graphics software of all the packages in the form of a simple paint system. It lets you place the captured image on the display screen and zoom, crop, annotate, and perform simple paint routines to enhance it. Some of the systems, however, like the otherwise fine Instant Image Talk Workstation System, won't let you touch the captured image at all.

Storage. Since the picture files created and saved with the picture database software are large, adequate storage space is often a problem. Therefore, determining how many pictures your system will contain is an important consideration in choosing a package. For now, you won't have much room on your hard disk drive for anything else if you decide to put pictures into your database, but new compression techniques may present a solution.

Database Connection. Today's picture database systems offer a number of interesting approaches to the database part of the equation. Some offer a simple flat-file database bundled as a part of the package. Others, like the Color PhotoBase System, provide a link to an external database. Still others, like the Instant Image Talk Workstation System, have invented their own associative databases. One product, the

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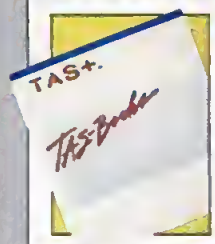

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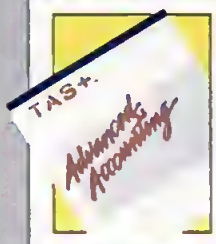

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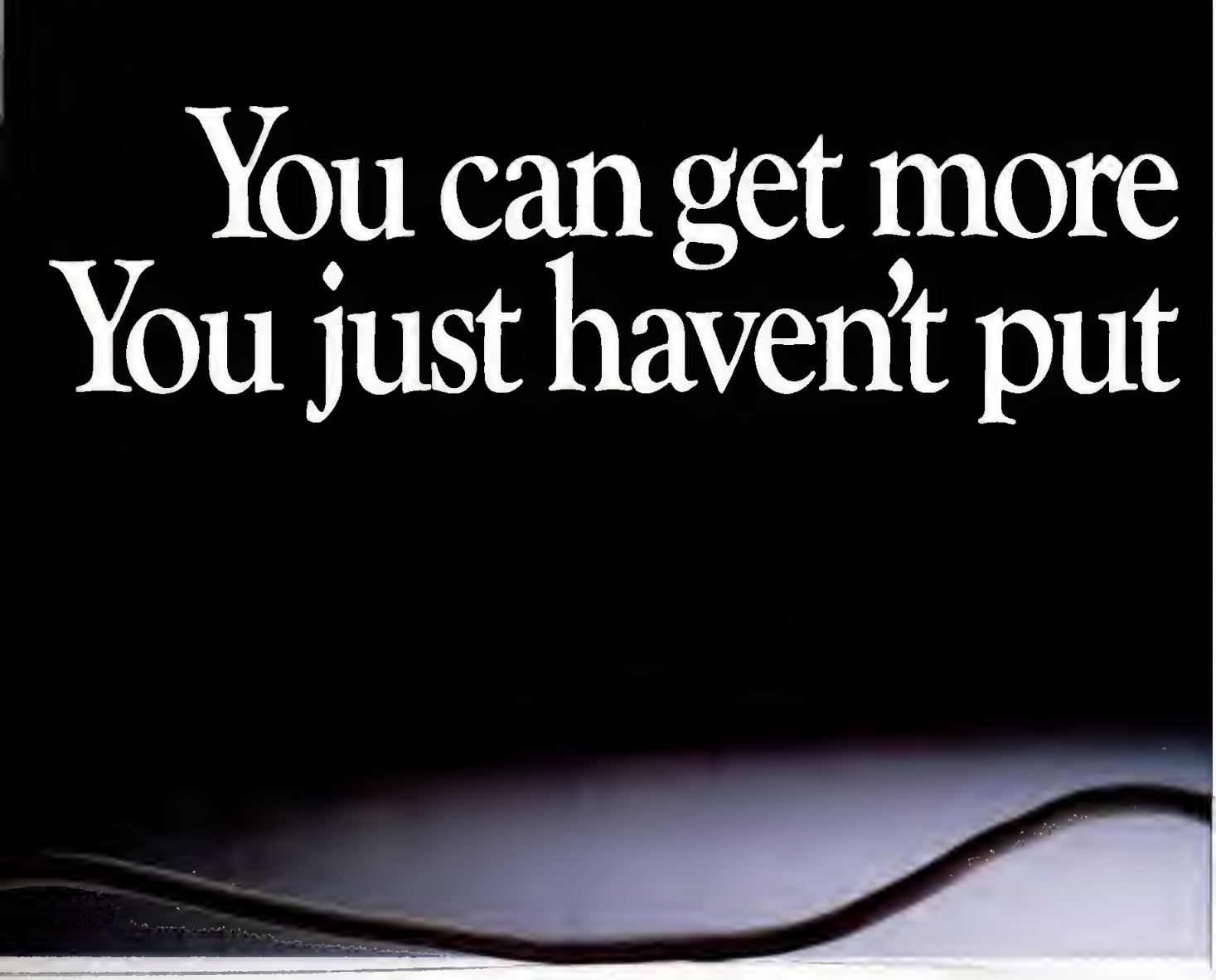

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Video Image File, has no database link at all, although you can write routines in programmable databases that will control the picture retrieval.

The simple built-in flat-file database is not very programmable and can't do any multicriteria searches. On the other hand, the integration between database and image is firm. With the built-in database, you call on a record, and the picture is retrieved transparently.

Links to external databases are fragile. Some picture database software programs, such as *Color PhotoBase* (because it's RAM resident), require the external database to use standard DOS-callable commands. Others, like *PicturePower*, rely on command routines that are built into a database (in this case, *dBASE III Plus*).

While it's certainly nice to be able to use your favorite database and incorporate pictures into it, the links, for the most part, require extensive knowledge of database programming language features. Furthermore, the instructions for managing the integration are embedded all over the place. After digesting the database manual and the picture database software and hardware manuals, you wind up adding a little hocus-pocus synthesis of your own.

PictureWare's *PicturePower* and *PicturePro-DB* are the only software packages we reviewed that offer both a simple flat-file database and a link to existing *dBASE* files. (Again, the link requires an intimate knowledge of *dBASE III Plus*.) This approach makes it possible to do your "serious" database work using *dBASE* and to recall pictures using the simpler database.

THAT'S THE TICKET Almost all of the packages offer extensive customized applications support. The developers are ready and willing to write your picture database applications for you—for a fee. A twist on this theme is *VisionBase*, which besides coming with a set of tools, offers a variety of prefab vertical packages for different database applications areas. Current offerings include criminal justice, real estate, archive, personnel, and inventory.

Otherwise, the picture database motto seems to be "ask, pay, and ye shall receive." At least one manufacturer responded to each of our questions about its product's capabilities not with a yes or no, but with a "Sure, we can customize it that way." This phenomenon is partly explained by the fact that many of these companies are "one-stop-shops" selling hardware, software, customized applications, training, or all of the above, to respond to the needs of any user with a budget to match.

Because these systems rely on hardware from other sources, documentation instructions such as "Check the manual for the display adapter" or "Switch settings should conform to Targa manual" or "Check DIP switches and change them if they are incorrect" abound. Brush up on your troubleshooting and research skills; you'll need them.

■ There are no easy answers when it comes to picture database systems. But the road to fully functional systems is no longer impassable.

ON THE PERIPHERY A number of peripheral items may ultimately solve some limitations of the present systems:

WORMs. Stored video images are storage hogs. Some of the packages already offer seamless interfaces to various WORM optical storage devices. By and large, the WORM installations and setups are straightforward, but including them tacks another $6,000 onto the already high price tag. The new WORM from IBM, however, costs only $3,000. Some manufacturers (PictureWare, for example) say they will support WORMs shortly, but now they are hampered by the necessity of storing all the pictures in a single database file, making writes of an individual record to the WORM impossible.

Picture Compression. Pictures chew up computer storage space. A full-screen PicturePower Color System image is 313K bytes, a quarter-screen image requires 84K, and a full-screen Color PhotoBase System image takes 50K. New adjunct software/hardware products such as ALICE (see sidebar "Compressing Images with ALICE"), a high-speed image compression system, promise to reduce picture transmission time and increase picture storage capability. An ALICE-compressed picture file can require as little as 8K. As it stands now, though, picture database developers must write the code to hook into ALICE's library of routines. This makes ALICE another "not yet ready for public consumption" product.

Videodisks. Graphics capture and display problems may be eliminated rather than circumvented by using an analog storage device such as the videodisk. Videodisk-based systems, like the Video Image File, use the camera as input and store the image on the videodisk. The PC, which controls the videodisk through an RS-232 port link, manages the videodisk search with database software. Storage-capacity problems are gone because videodisks, such as the one the Instant Image Talk Workstation System uses, can store about 24,000 images. Videodisks can talk, too! The Instant Image Talk System adds sound to its picture database by using a relational database of sounds, keywords, and pictures.

Output. High-resolution, full-color images have very few outputs to the hard-copy world. Full-color printers are both expensive and finicky. Color database packages tend to prefer producing thermal transfer output, available on esoteric printers from Hitachi and Mitsubishi. Some support a film recorder or two, most typically the Truevision Film Printer from AT&T and/or the Polaroid Palette. Most have plans to accommodate the HP Laserjet in the future. We had little luck printing discernible images with the systems that offered output to the low-end printers, such as Epson's FX series.

TRUE COLORS The computer industry is notorious for making users believe it has easy answers. But there are absolutely no easy answers when it comes to picture database systems. The road to fully functional systems, however, is no longer impassable. The totally integrated systems

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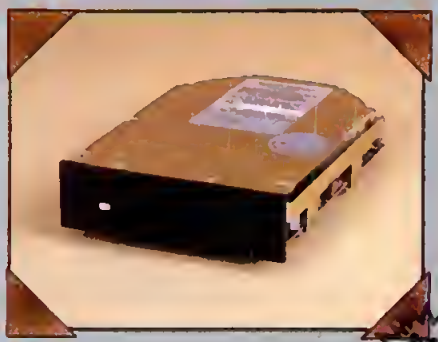

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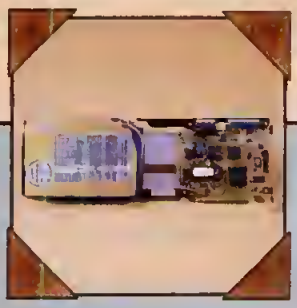

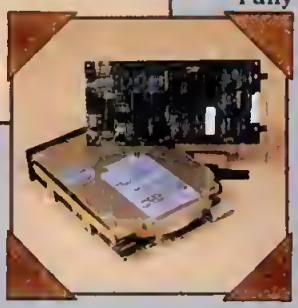

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By Mike Mabon
Hard Drive Engineer

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COMPRESSING IMAGES WITH ALICE

Digitized images eat disk space. But ALICE maximizes the number of pictures you can store on a disk by shrinking picture size or compressing images.

One inescapable truth about digitized images is that they eat up disk space. The better the image, the more disk space it eats up. A full-screen image on the AT&T Targa 16 board uses 410K bytes. Add the overscan option to fill out the picture's borders, and the file size goes up to nearly 500K. This yields a meager 2 pictures per megabyte, or 20 pictures per 10 megabytes.

The simplest way to maximize the number of pictures you can fit on a single disk is to shrink the picture size. A quarter-screen image is both large enough and detailed enough for most purposes, yet it takes up only a fourth as much disk space, yielding about 100 pictures per 10 megabytes.

Another option is to compress the image, shrinking the storage requirements without shrinking the picture. But you wouldn't want to use a picture database that depended on software-based compression and decompression—it's torturously slow.

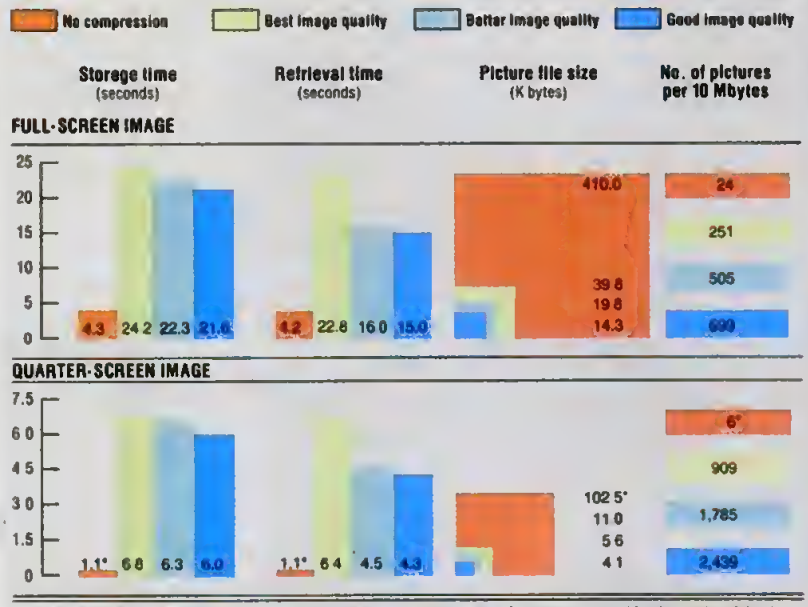
Enter ALICE from TelePhoto Communications. ALICE, an acronym for Advanced Low-cost Image Compression/Expansion, is the hardware/software answer to image compression and decompression. The hardware is a full-sized PC board that includes a Texas Instruments TMS 32020 high-speed signal processor and 4K bytes of 50-nanosecond RAM that perform the numeric-intensive image processing. The TI chip functions as a coprocessor for image compression and decompression. It speeds up the process, just as an 8087 or 80287 coprocessor speeds up math functions, because it is optimized to the task. The coprocessor architecture also saves time by allowing simultaneous image compression and disk access.

The software side of ALICE is primarily a series of drivers written in Microsoft C. If you're writing a program from scratch, you can incorporate the drivers as needed. Unfortunately, if you aren't writing your own program, the only way to use ALICE is to buy software that already supports the board. As of this writing, off-the-shelf picture database programs offer no such support, although PictureWare is working on including the ALICE routines in its next release of *PicturePower*.

ALICE comes in four versions: one (ALICE 320S4-10) for the AT&T Image Capture Board, two (ALICE 320S4-11, ALICE 320S4-12) for AT&T Targa boards, and one (ALICE 320S4-20) for the Imaging Technology FG100 series. For this review, I tested ALICE with Targa 16 images, using the ALICE demonstration program. This simple program has no database functions, but it does allow for image storage and retrieval at four levels of picture quality. The highest-quality level is without any compression, using the Targa 16's full 410K-byte file. The other three levels are called good, better, and best.

Performance Tests: ALICE 320S4-11

Using the ALICE image compression system, even in the "best" mode, which offers the least compression, files are ten times smaller than with no compression. In the "good" mode, which compresses images most, files are 30 times smaller. In all cases, the compression process extracts a penalty in performance time for storage and retrieval.



*These results are extrapolated from those for the full-screen image test. The program used for the testing did not allow us to test quarter-screen images with no compression. However, because the Targa board, which ALICE works with, allocates a fixed amount of memory for each pixel stored, a quarter-screen image would take up one-fourth as much memory (about 102K) as the full-screen image tested here.

SPACE The good level uses less disk space than the better, and the better level uses less disk space than the best. Even at the best-quality level, the amount of compression is impressive. On a full-screen picture of a human face, compression was 10 to 1 or better. The 410K bytes needed for a Targa file turned into 39.8K for best quality, 29.8K for better quality, and 14.3K for good quality. On a more-complicated picture of a person in an office, with a desk and bookshelves in the background, the file sizes were slightly higher, ranging from 53.3K for best quality to 23.1K for good quality. Even at 53.3K for each image, storage capacity per 10 megabytes jumps from only 24 images to a more-respectable 187 images. On quarter-screen images, the file sizes drop to a mere 11K for best quality and 4.1K for good quality. This translates to a storage capacity per 10 megabytes of 909 best-quality pictures, or 2,439 good-quality pictures.

QUALITY Both full-screen and quarter-screen pictures showed visible differences in quality between good and better, better and best, and best and no compression. The good-quality full-screen image of a human face shows no loss in the Targa 16's 512 by 400 resolution, but shadows that should show gradual shading instead show lines that look like isobars on a weather map. The better-quality compression shows some of the isobar effect as well, but not to the same extent as the good quality.

The best-quality picture shows almost none of the isobar effect. You're not likely to see it there unless you look for it. And even if you do look for it, the difference between best-compression quality and no-compression quality is subtle. If you have a good-quality image on the screen and retrieve the identical image saved as better quality, you can easily see the better-quality image being written over the good image, a half-inch bar at a time. If you have a best-quality image on the screen and retrieve a no-compression image, you can't see the new image being rewritten. Instead, the overall image appears subtly improved.

With quarter-screen images, the quality difference between good and better was not as overwhelming as with full-screen images. You might not even notice the isobar effect in the good-quality pictures unless you know it's there.

On the more complex full-screen picture showing a person in an office, the loss of color shading in good-quality compression introduced a perception of grittiness in resolution. The grittiness is subtle enough so that you can't see the screen being written over when loading a better-quality file of the same image, but you can see a subtle change.

TIME Just as important as picture quality or file size is time. For full-size pictures, ALICE's compression and decompression times are marginally acceptable. Compression and storage times range between 21 seconds for good quality and 24 seconds for best quality. Retrieval time is a little better, with 15 seconds for good quality and 22 seconds for best quality. This compares with just 4 seconds for storage and retrieval with no compression or decompression.

Quarter-screen pictures fare better, yielding compression and storage times of 6 to 7 seconds and retrieval times of 4 to 6 seconds. These times are too long for comfortably flipping through a picture library, but they should be adequate for most picture database applications.

ALICE will soon include a communications feature. New drivers will let you transmit and receive images over standard phone lines, using a 300- to 9,600-bit-per-second modem connected to ALICE's RS-232C port. The communications driver will let users display an image, then compress and transmit that image to a second location. The ALICE board at the second location will be able to receive, decompress, display, and store the image. If you need to transmit images among multiple locations, the savings in phone bills alone could pay for the cost of the ALICE package.

ALICE is clearly at the leading edge of picture database technology. Even at $1,495, ALICE gives you far cheaper storage capacity than you'd get by buying the equivalent number of hard disks or WORM drives.—**M. David Stone**

FACT FILE

ALICE
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List Price: ALICE 320S4-11 (AT&T Targa 16 compatible), including 4K RAM, TI TMS 32020 chip, and compression software, $1,495. ALICE 320S4-10 (AT&T Image Capture Board series compatible), including 4K RAM, TI TMS 32020 chip, and compression software, $1,395. ALICE 320S4-12 (AT&T Targa 24 compatible), including 4K RAM, TI TMS 32020 chip, and compression software, $1,545. ALICE 320S4-20 (Imaging Technology FG100 series compatible), including 4K RAM, TI TMS 32020 chip, and compression software, $1,495.
Requires: 640K RAM, hard disk recommended, DOS 2.0 or later, AT&T's *TIPS* software or PictureWare's *PicturePower* software.
In Short: Given the way picture files eat up disk space, the 10-to-1 compression of the ALICE board is clearly worth the price. Keep your eye out for software that supports this board. Compression software not copy protected.

CIRCLE 692 ON READER SERVICE CARD

approach of companies like PictureWare is opening up new avenues.

As videodisk storage becomes more affordable, the players and their products are likely to change rapidly. Already, hints of future enhancements and modifications are leaking from the headquarters of the picture database developers. Although a picture is in this case much harder to come by than a thousand words, picture databases are slowly beginning to show their true colors.—**Robin Raskin**

Robin Raskin is a frequent contributor to PC Magazine.

The Video Image File uses analog recording techniques, with a resolution of 280 lines. The text relating to a record appears on the computer screen (not shown), while the pictures show up on the analog monitor. The recorded image has a noticeable grain.

Photograph: Thom O'Connor

CALCO DIGITAL EQUIPMENT INC.

Video Image File

The Video Image File, from Calco Digital Equipment, is a fast, high-capacity image capture and retrieval system for black-and-white pictures. Priced at just $3,295 plus the cost of a camera and monitor, it is also one of the least expensive routes to creating a picture database.

The Video Image File is an intelligent RS-232 device. It connects to your computer's communications port and controls all picture capture, storage, and retrieval. You control it by giving your PC a handful of simple commands.

Physically, the Video Image File is a box 12 inches high, 3½ inches wide, and 11 inches deep containing a 20-megabyte hard disk drive, a custom controller board, and firmware that interprets commands. The unit will work with any composite color or black-and-white camera and any composite color or black-and-white analog monitor.

INSTALLATION A one-page flyer serves as a quick reference card, giving all the specifications and a list of commands. A two-page, typewritten, "technical" document explains DIP switch settings, potentiometer adjustments, and other technical setup information that you probably won't need. The surprise is that this meager documentation contains everything you need to know.

Compared with the other systems, setting up the Video Image File is simple. You just plug in the camera and monitor and run a straight-through cable between the computer and the Video Image File box. The RS-232 port on the box uses the same female DB-25 connector that you'll find on a modem. In operation, all pictures show up on the analog monitor. All text shows up on your computer screen.

Software setup is equally simple. The Video Image File comes with a demo disk that boots up in drive A: and automatically takes you to a menu. The menu includes a choice of three demonstration programs and instructions for each. If you feel more comfortable with printed documentation, you can escape to DOS and print out the disk-based instructions.

Two of the programs are truly demo programs. They're fun to play with and show off the product's capabilities, but they have no practical application. The third program is potentially useful—a flat-file database manager that may well be all you need.

The database manager, Nurse, was originally designed to give doctors quick access to patient information and images produced by X rays, ultrasound, CAT scans, and the like. But the accompanying install program allows users to rename the fields. Six data fields are available, each holding up to 40 characters. Field names may be up to 25 characters long. To change any of the field names, you simply type in the new ones.

The install program will also let you define the number of video pictures to reserve for each record. You can reserve as many as you like, but you are best advised to stay with a reasonable number, both to leave a maximum number of records available and because when you start entering pictures for any given record, you have to enter them all. When creating a database, be sure to plan this setting carefully. If you

FACT FILE

Video Image File
Calco Digital Equipment Inc.
1409 Kuehner Dr., #141
Simi Valley, CA 93063
(805) 584-0245
List Price: $2,995, including hard disk and *Video Image Demo* software.
Requires: 256K RAM, one floppy disk drive, black-and-white or color composite camera, black-and-white or color composite monitor, RS-232 port, DOS 2.0 or later.
In Short: Priced at just $2,995 plus the price of camera and monitor, the Video Image File can hold 2,460 black-and-white images. This makes it the least expensive system for moderate-sized picture databases. Software not copy protected.

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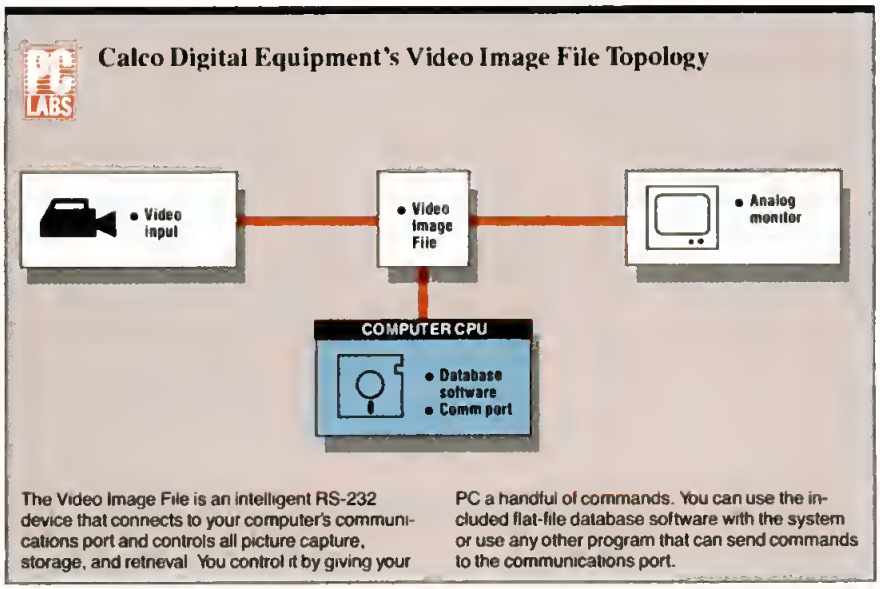

The Video Image File is an intelligent RS-232 device that connects to your computer's communications port and controls all picture capture, storage, and retrieval. You control it by giving your PC a handful of commands. You can use the included flat-file database software with the system or use any other program that can send commands to the communications port.

change your mind at a later time, the pictures already on disk will be reassigned to other records.

USING THE DATABASE Using the program is just as simple as installing it. Whenever you start Nurse, the program shows you a list of records, using the first field in the database. You can use cursor keys and the Return key to choose the record you want, or you can go to a main menu. At the main menu, your choices are to add an item, recall or edit an item, or search the item list. The recall and edit option lets you search for a record by filling in the field or fields you want to match. You can then page through the file looking at each match. The option "Search Item List" takes you back to the original screen list of entries.

Adding and editing records are virtually identical processes. The program puts the data entry form on your screen, and you enter or edit data for your record. You then pick Replace Pictures, and the program asks you to aim and focus the camera, then press Enter to shoot. If you already have images on the Video Image File, you can retain the current picture. After choosing to replace or retain all pictures that go with the record, Esc will take you back to the record entry screen. You can also browse through the pictures.

Missing from the database is any facility for sorting, indexing, importing, exporting, or printing records. If you need these or other features, you'll have to develop your own program. The Nurse program is written in compiled BASIC and is supplied with source code for you to build on. Alternatively, you can control the Video Image File through *dBASE* or any other program that can send commands to the communications port. As of this writing, Calco will supply a disk of *dBASE* routines for $50, but you must still develop a *dBASE* program to take advantage of the routines. Worse, the routines are not well documented, so you'll have to study them carefully to understand what they do. Calco hopes to supply better hooks for *dBASE* in the future, but for the moment, all but the most-experienced programmers are advised to think twice before attempting to tackle this job.

FAST CAPTURE/RETRIEVAL The Video Image File is impressively fast on both image capture and retrieval. Calco claims 1/60 second for hardware image storage time, and 1/5 second as "worst-case" for image retrieval. With the demonstration software, Calco claims that the Video File Image can actually record 6 to 6½ fields per second. This is too fast to time by hand, but the claims seem fair.

Using the demonstration software program, I was able to capture picture after picture quickly enough to produce what amounted to a video flip book of moving pictures. Retrieval was also impressively fast, letting me flip from picture to picture just as quickly as I was able to hit the forward cursor key.

One minor problem is that the recorded picture is noticeably grainier than a live picture. The Video Image File uses analog recording techniques, with a resolution of 280 lines. According to a Calco representative, this resolution is roughly equivalent to a digital resolution of 512 by 256 pixels. The picture quality seems adequate for most purposes.

Very much on the plus side is the Video Image File's storage capacity. Thanks to the analog recording techniques, a single Video Image File unit can hold 2,460 pictures. What's more, you can daisy-chain up to eight Video Image Files on a single RS-232 port. This translates to a maximum capacity of 19,680 pictures for each RS-232 port on your system.

Because the Video Image File is an analog device, it lacks any facility for digitizing and manipulating the picture. A Calco representative pointed out that you can use the output from the Video Image File as input to a digitizing board, edit the picture with your choice of software, then take the edited picture and feed it back as input to the Video Image File. This process, which requires juggling cables between input and output ports, is too clumsy, though, to be relied on regularly.

■ The Video Image File is impressively fast on both image capture and retrieval.

The Video Image File has staked out its claim at the low end of the picture database spectrum. If you need a relational database or features that are missing in the demonstration program, expect to write your database from scratch. But if black-and-white pictures and a simple flat-file database manager will suit your needs, the Video Image File may serve as an off-the-shelf solution.—**M. David Stone**

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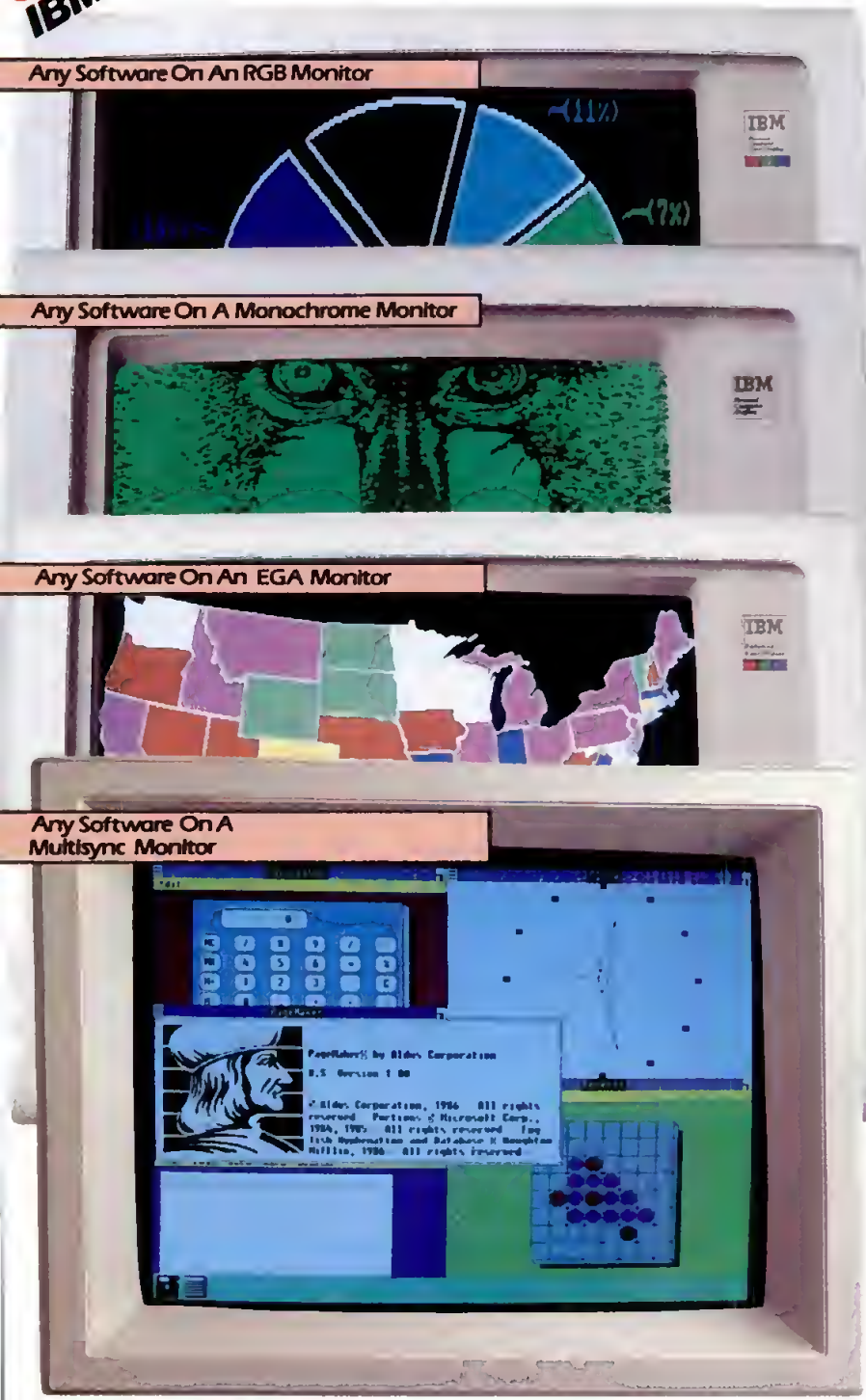

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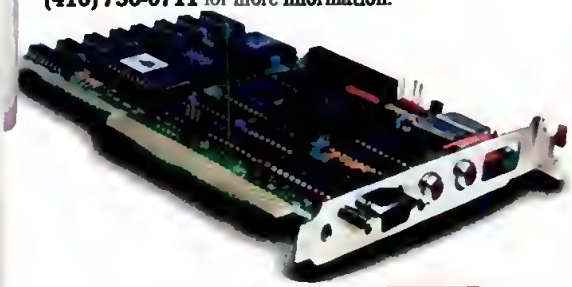

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CHORUS DATA SYSTEMS

Color PhotoBase System

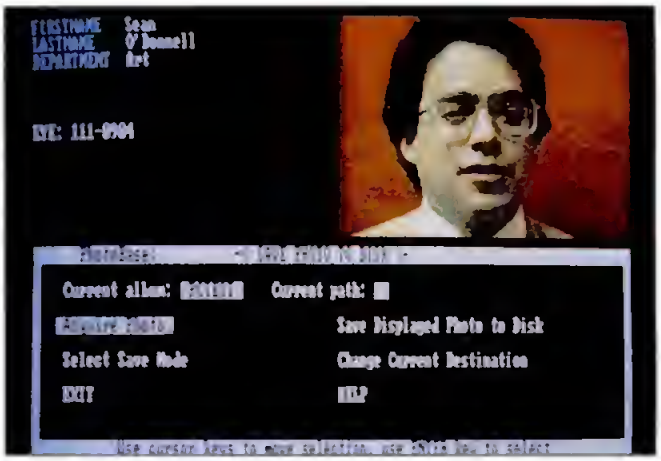
The Color PhotoBase System, from Chorus Data Systems, is the budget entry among color picture database systems. The $4,495 system—minus the computer and your choice of database program—includes a JVC RGB video camera bearing a Chorus nameplate, a Quadram Palette Master display board, a Sony CPD-1201 monitor, assorted cables, and a Kaiser reproduction stand consisting of base, camera stand, and lights. Also included is Chorus's own Video Capture System, Which consists of the PC-Eye board and *Color PhotoBase* software.

The product works with *dBASE III* (which it was tested with), and, according to Chorus Data Systems, it also works with *dBASE II*, IBM's *Filing Assistont*, *PFS:File*, the complete *R:base* series, *Revelation*, and any other program that handles video output either through DOS or through the ROM BIOS. It will not work with *dBASE III Plus* or other programs that control the hardware directly.

Chorus's Video Capture System, a combination of hardware and software, consists of the PC-Eye board for digitizing images and *Color PhotoBose* software, which captures the images to disk and also lets you link your captured images to a database program for retrieval.

■ The Color PhotoBase System, selling for $4,495, is the budget entry among color picture database systems.

If you'd rather piece together a system on your own, the Video Capture System and *Color PhotoBase* software are available separately; they'll work with any RGB camera and any analog RGB monitor. However, buying the complete package is a significant convenience. It ensures that you won't run into cabling problems during installation.



The Color PhotoBase *software captures images to disk and allows you to link captured images to a database program for retrieval. The product works with any database program that handles video output through either DOS or the ROM BIOS. Text and image appear on the same monitor.*

INSTALLATION Unfortunately, you are almost guaranteed to run into other problems. Chorus's installation manual is not well thought out. The section on installing the PC-Eye board, for example, includes the instruction to check the jumpers and "change them if necessary." The manual then refers you to a carefully drawn figure, showing each jumper's location on the board. But the manual does not tell you why you might want to change the jumpers or what to change them to. An addendum to the manual gives information on one jumper; that still leaves four mysteries.

Almost making up for the problems with the manual is the informed technical support. Each time I ran into a problem, I called Chorus (even though the company does not provide a toll-free number) and was immediately given the information I needed. Apparently the company finds it cheaper to staff the phones than to write a new manual.

Once you've deciphered the manual, hardware installation is reasonably straightforward. In most cases you won't have to change any jumpers, so you can usually just plug in the PC-Eye board. Next, you replace your CGA or EGA, if you have one, with the Quadram Palette Master board. You then plug in the cables between the camera and the PC-Eye board and between the analog monitor and the Palette Master.

DISPLAY Quadram's Palette Master gives you several display choices. The analog monitor itself will function both for pictures and for standard DOS programs. The board also has a CGA-compatible port and a composite port, so you can plug in an IBM color monitor, a composite color monitor, or a composite monochrome

FACT FILE

Color PhotoBase System
Chorus Data Systems
P.O. Box 370
6 Continental Blvd.
Merrimack, NH 03054
(603) 424-2900
List Price: $4,495, including *Color PhotoBase* software, Quadram Palette Master GA-1200 graphics board, JVC RGB video camera, Sony CPD-1201 analog RGB monitor, PC-Eye Video Digitizer, PC-Eye Software Developer Support, Kaiser copy stand with lights, cables, power strip. Color PhotoBase System with WORM drive and all features listed above, $10,495.
Requires: 195K RAM above the amount needed for the application being used (640K RAM recommended), hard disk recommended. DOS 2.0 or later.
In Short: Based on Chorus Data Systems' own PC-Eye technology, the Color PhotoBase System suffers from slow capture time and lesser picture quality than systems built around the AT&T Targa 16. Even so, it has the advantage of being a less expensive technology and of needing less disk space. The system may be attractive to those who want color images on a tight budget. Software not copy protected.

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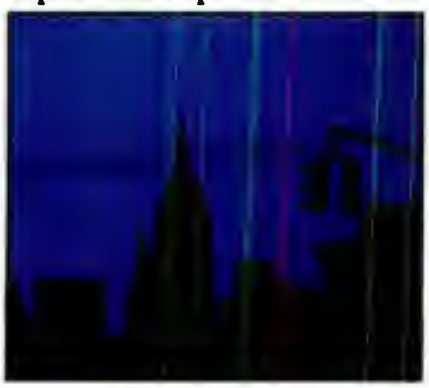

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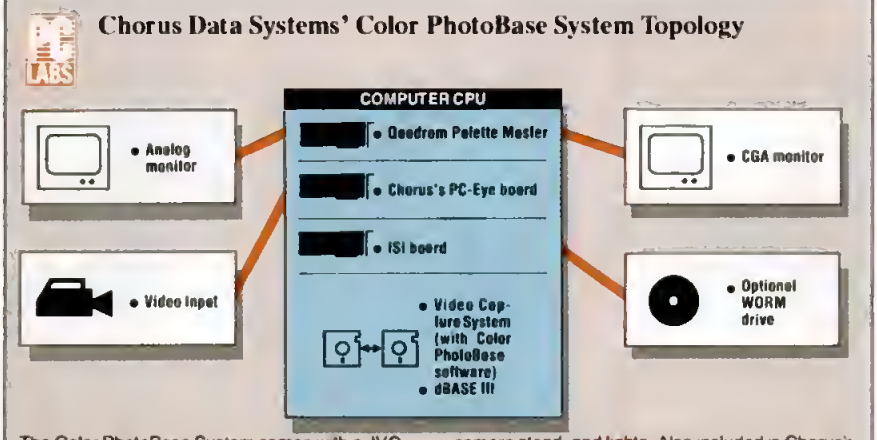

The Color PhotoBase System comes with a JVC RGB video camera bearing a Chorus nameplate, a Quadram Palette Master display board, a Sony CPD-1201 analog RGB monitor, assorted cables, and a Kaiser copy stand consisting of a base, a camera stand, and lights. Also included is Chorus's Video Capture System, which consists of the PC-Eye board for capturing pictures to disk and *Color PhotoBase* software. The optional ISI WORM drive gives you 240 megabytes of storage per cartridge.

monitor. You can also have a standard monochrome card in the system, along with the Palette Master.

To test the program, I used the second combination—plugging in a standard color monitor along with the analog monitor. This let me see text on both screens simultaneously. Interestingly, the analog monitor showed less screen flicker than the standard monitor when scrolling text.

In general, if you want to use quarter-screen pictures in your database, the analog monitor by itself should be enough. If you plan to use full-screen pictures, you'll want a second monitor for text—another important piece of information that isn't explained in the manual.

Software installation is almost trivial. The manual gives detailed instructions for creating a PC-Eye subdirectory on your hard disk and copying the program from the distribution disk.

Once installed, the Color PhotoBase System is easy enough to learn and use, but its basic design is primitive, if not clumsy. The hardware itself is a problem. The PC-Eye board takes several seconds to digitize a picture, yielding a series of half-inch bars across the screen whenever you move the subject or try to focus the camera. If you set the software to snap a picture, you have to aim, zoom, and focus by a kind of dead reckoning. If you set it for continuous capture, you get a ripple effect on the screen with each change in the picture. According to a Chorus representative, the ripple effect is a direct result of the less expensive technology used in the PC-Eye board, as opposed to that of the AT&T Targa 16 board, for example.

Chorus lets you offset this problem by plugging a monochrome composite monitor into the PC-Eye board for real-time pictures without the ripple effect. While this lets you focus more easily, it also adds an extra monitor to your system and is far from an elegant solution.

Less-than-perfect color fidelity results from both a hardware and a software problem: the hardware supplies only 256 colors, while the software allows color adjustment for only the black and white levels. I wasn't able to reproduce anything close to the correct colors and was especially unhappy with skin tones. In fairness, the manual shows far better color samples than I was able to produce, and a Chorus representative said that this is a function of learning how to use the system.

Notably absent is a feature for manipulating the picture. The program will let you store and display pictures as either full-screen or quarter-screen, but there is no way to define other picture sizes, and no way to crop, delete, rotate, or otherwise modify the picture.

Although the *Color PhotoBase* software has no database functions, it is designed to work with most database programs. RAM-resident, it sits quietly in the background, reading your screen and waiting to see "EYE:" followed by the picture name. When it sees the cue, *Color PhotoBase* searches for a picture with the appropriate name. If it finds one, it puts it on-screen. If not, it puts up a menu that lets you capture the picture. Because of the way it links to the database program, *Color PhotoBase* makes it easy to add photos to an already existing database.

WORM OPTION Chorus also sent along an ISI WORM drive for testing. This option is important because digitized pictures can take up a lot of disk space, and it doesn't take a large database to fill up a 20- or 30-megabyte disk. At 53K bytes for a full-screen picture and 13K for a quarter-screen one, the *Color PhotoBase* files are smaller than those of most picture capture systems, but even for quarter-screen pictures, that still translates to less than 800 pictures per 10 megabytes. The WORM drive contains 240 megabytes of storage per cartridge, with 120 megabytes per side.

The WORM drive cost $6,000, available from ISI for use with any picture database system. Normally with a WORM drive you must save to the hard disk and then copy to the WORM. The Color PhotoBase System offers the convenience of writing directly to the ISI drive. (This feature will work with ISI drives only.)

■ *Color PhotoBase* makes it easy to add photos to an already existing database.

Despite some important drawbacks in picture quality and manipulation, the Color PhotoBase System offers an acceptable package for storing and retrieving digitized pictures. If you can manage with less than the best possible picture quality, and if you want to minimize the need to buy additional storage devices, the Color PhotoBase System may be your choice for a picture database system.—**M. David Stone**

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The VisionBase *program saves all pictures as full-screen images, with a maximum of six pictures per record. Each vertical market program uses DOS routines—the Criminal Justice module (reviewed here) is written in* dBASE III Plus.

CORE ANALYTIC INC.

VisionBase

VisionBase, from Core Analytic, is not a single product. It is, rather, a set of vertical market packages, each of which furnishes a turnkey solution for a particular picture database application. The various versions of *VisionBase* include *VisionBase/Archiving*, *VisionBase/Criminal Justice*, *VisionBase/Real Estate*, *VisionBase/Personnel*, and *VisionBase/Inventory*.

Besides its turnkey incarnations, *VisionBase* also contains a series of DOS routines for capturing, saving, and retrieving images. These routines are an integral part of each *VisionBase* application. And for those who are willing to write their own applications, the DOS routines are available separately, in a package called *VisionBase/Tools*.

Each *VisionBase* tool is a small DOS program that you can run from the DOS command line. Type FREEZE at the C> prompt, for example, and you will see a live image on your monitor at which you can aim and focus your camera. Hit Enter or the Spacebar, and your capture board will capture the image to memory. To save the image to disk, run another program, SAVE. And to retrieve the image, run the program SHOW.

Because *VisionBase/Tools* consists of a series of DOS routines, you can run them from *dBASE*, *R:base*, or any other database program that can make DOS calls. The *VisionBase* vertical market packages are all written in either *dBASE III* or *dBASE III Plus*, and all are compiled with *Clipper*.

INSTALLATION *VisionBase* is software. A Core Analytic spokesman says that the company supplies cameras, capture boards, display monitors, and cables if requested to do so but offers no overall package as such. The *VisionBase* manuals assume that your hardware is already set up, and they begin with software installation. Fortunately, the hardware setup is not difficult.

VisionBase packages come in two flavors, one for the AT&T Image Capture Board (ICB) and one for the AT&T Targa boards. Core Analytic sent the Targa version for review. As mentioned elsewhere, the Targa manual is good enough that you should be able to set up the board without trouble: simply set the appropriate DIP switches, plug the board into your computer, and plug the camera and monitor into the board. The thoroughness of Targa's manual aside, I would be happier if the *VisionBase* manual included an overview of hardware installation.

When used with the Targa 16 board, *VisionBase* will work with any RGB camera and with any composite color or black-and-white camera. It will also work with VCRs, scanners, and videodisk players. And it will work with any analog color or black-and-white monitor. In testing *VisionBase*, I used the same JVC RGB camera, AT&T Targa 16 board, and Sony CPD-1201 analog monitor that I used with the *PicturePower* software.

The *VisionBase* manual gives careful directions for software setup, including detailed instructions for creating a CONFIG.SYS file, creating a *VisionBase* subdirectory, and starting the install program, which copies files from floppy disks to the hard disk.

For this review, Core Analytic supplied the *VisionBase/Criminal Justice* version. Although it's reasonable to assume that this package is representative of the group, keep in mind that details will vary from one package to the next.

The *VisionBase/Criminal Justice* program is written in *dBASE III Plus*. The carefully designed program is straightforward enough so that you can learn it simply by experimentation.

The main menu offers five choices: Book a Name, Search, Reports, Communications Mode, and Utilities. The Book-a-Name option lets you add or update a record. With the Search option, you can enter an existing search criterion or create a

PC MAGAZINE FACT FILE

VisionBase
Core Analytic Inc.
674 Rte. 202-206 North
Bridgewater, NJ 08807
(201) 218-0900
List Price: AT&T Image Capture Board version, $595; AT&T Targa 16 board version, $995.
Requires: 640K RAM, hard disk, AT&T Targa 16 board or AT&T Image Capture Board, analog RGB or composite color monitor, RGB or composite color TV camera, DOS 2.0 or later.
In Short: *VisionBase* is available either as a tool kit for programmers or as one of a choice of vertical market packages written in compiled *dBASE III* or *dBASE III Plus*. These packages use either the AT&T Targa 16 board or Image Capture Board, taking advantage of their high-quality pictures. Not copy protected.

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- The calculator, with exponential display, which performs arithmetic and financial calculations.
- The notepad, which records ideas, memoranda, and notes.
- The appointment book, with audible alarm, which maintains daily, weekly and monthly calendars.
- The kaleidoscope, which customizes the accessory display for color monitors.
- The configuration, which manages the memory allocation of Metro and customizes its functionality.
- And the special characters, which serve as a reference for ASCII characters.

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Lotus Metro runs with a wide variety of software programs, including 1-2-3,® Symphony,® Symphony Spelling Checker, Symphony Text Outliner, 1-2-3 Report Writer,™ and Signal™

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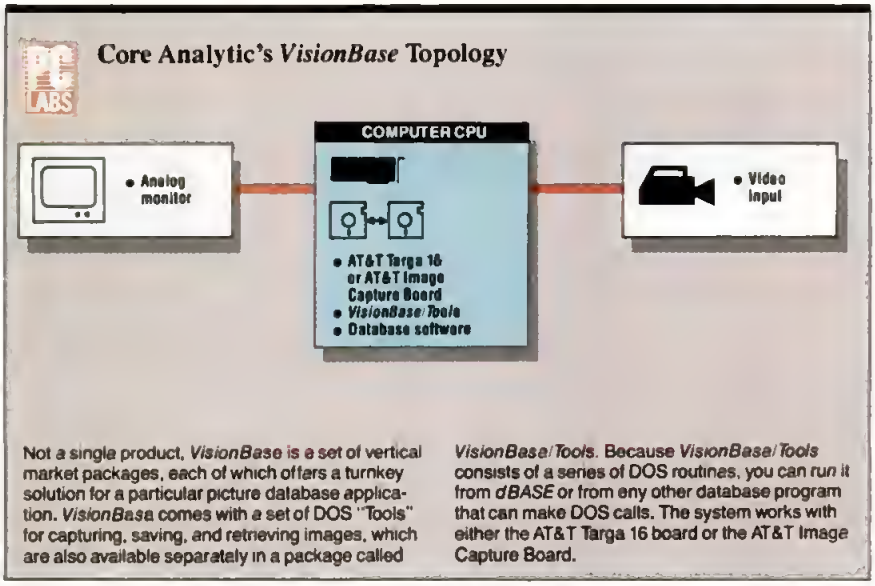

Not a single product, *VisionBase* is a set of vertical market packages, each of which offers a turnkey solution for a particular picture database application. *VisionBase* comes with a set of DOS "Tools" for capturing, saving, and retrieving images, which are also available separately in a package called *VisionBase/Tools*. Because *VisionBase/Tools* consists of a series of DOS routines, you can run it from *dBASE* or from any other database program that can make DOS calls. The system works with either the AT&T Targa 16 board or the AT&T Image Capture Board.

new one, using Boolean logic guided by *dBASE III Plus* menus. Reports lets you similarly select or create a report. With the Communications option you can run your communications program from within *VisionBase/Criminal Justice*, without exiting to DOS. The Utilities option lets you delete records, delete saved searches, and index your files.

When you're running the *VisionBase* program, all text is displayed on the PC's monitor, and all pictures on the analog monitor. Program prompts guide picture capture; you simply aim, shoot, and snap, using the Return key or Spacebar to capture the picture. The package saves all pictures as full-screen images, with a maximum of six pictures per record. The six-picture limit is incorporated into the *dBASE* program file; it's not a limit of the underlying *VisionBase* tools.

TIMING For testing image file sizes, storage time, and retrieval time, I dropped into DOS and used the *VisionBase* tools directly. The results were typical for programs using the Targa 16 board. A full-screen image took about 4 seconds each for storage and retrieval and required 410K bytes.

The *VisionBase* SAVE routine also has an option for run-length-encoded compression. It produces only moderate compression, yielding a 318K-byte file for a close-up of a face and a 290K-byte file for a nearly empty frame. Unfortunately, the cost in time is significant, with storage time jumping to 20 seconds and retrieval time jumping to 14 seconds. For most applications, the savings in space doesn't seem worth the cost in time.

VisionBase also has a tool for saving quarter-screen images, but this isn't used in the *Criminal Justice* package, so it isn't included on the disk. Core Analytic also has another advanced tool that lets you write text over the image, but this too is included only with the packages that make use of it.

Although neither of these advanced tools are included in the basic *VisionBase/Tools* package, both are available, in ICB version only, in an enhanced tool package. According to a Core Analytic representative, additional advanced tools are being developed.

PERSPECTIVE ON VALUE Whether you consider *VisionBase* to be a good value or not depends on your perspective. The Targa versions of the vertical market packages are $995 each, and the ICB versions are $595 each. This puts them head to head with *PicturePower*, with its easy-to-use, flat-file database program and its image-editing features. There's no question that you can do more with *PicturePower*, but it will cost you time and effort. One important disadvantage to the *VisionBase* packages is that they come without source code, so you can't modify the database structure without starting from scratch. But if the package serves your needs as is, that isn't a consideration.

VisionBase/Tools, in contrast to the vertical market packages, costs only $295 for the Targa version, $195 for the ICB version plus $195 for the ICB advanced tools. That makes these packages significantly cheaper than the competition, *PicturePower*. And if you have an application that you have to write from scratch, you'll find that writing the application for *VisionBase/Tools* is no more difficult than writing it for *PicturePower*. Neither program provides much documentation or sample files, and both assume that you are intimately familiar with your database program. So if you don't need *PicturePower*'s image-editing capabilities, you may want to save $700 with *VisionBase*.—**M. David Stone**

PICTUREWARE INC.

PicturePower Color System

The PicturePower Color System, from PictureWare, is the only product tested that qualifies as a ready-to-use, off-the-shelf database management system for pictures. The *PicturePower* software package includes its own picture capture facility, picture editor, and database manager, complete with forms generator. It even has a built-in data communications feature for transferring picture files between locations.

The complete $6,230 color setup PictureWare supplied for testing includes a JVC RGB camera, an AT&T Targa 16 board, a Sony CPD-1201 analog monitor, assorted cabling, and the *PicturePower* image capture and database software.

As with the *Color PhotoBase* software, the *PicturePower* software is available separately (at $945). But here again, as with the other products reviewed, buying the complete package is a significant convenience, and it helps ensure that you won't run into cabling problems. The program is also sold through AT&T, as *Truevision PicturePower*, for the same price.

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INSTALLATION Setting up this package is more complicated than installing a board in your computer, but not by much. The PicturePower Color System manual contains a good overview of the setup procedure, and it refers the reader to the specific manuals for each piece of equipment. Probably the hardest part of installing the system is setting up the Targa board, which isn't particularly difficult.

The Targa board functions as both the digitizer board for the video input and as the display board for the analog monitor. When using the PicturePower System, you can display both text and pictures on the analog monitor, or you can display pictures on the analog monitor and text on your CGA, EGA, or monochrome monitor. Standard DOS programs do not display on the analog monitor.

If you have a CGA or monochrome card in your system, you install the Targa board by plugging it in, connecting the cables from the Targa board to the camera and the Targa board to an analog monitor, and then running a self-explanatory installation program for the Targa board. If you have an EGA, you have to change some Targa DIP switch settings first, but the manual covers the changes in detail.

The PicturePower Color System uses a dBASE *file format and is designed to work with* dBASE III Plus. *The image and the program menu appear on the same screen. When setting up the picture field, you can set the picture to any size and can place it in any location on your screen.*

Installing the *PicturePower* software is easy. Here again, the manual is a good guide. One oversight in the program—and the manual—is that the program assumes you have a serial mouse. If you have a bus mouse, you'll have to reset it to use a communications port.

The program design is logical enough that you could probably learn it through trial and error, but the manual also includes a three-part tutorial that is well worth taking the time to do. Its Getting Started section introduces the picture editing commands Display, Save, Flip, Rotate, Trim, Fit, Airbrush, Bright, Annotate, Clear, Delete, and Print. These are all controlled through mouse commands only.

As the list of commands indicates, *PicturePower* offers a full complement of tricks for modifying your captured pictures. The commands are not always intuitive, but at least they are not counter-intuitive. The Fit command, for example, would better be labeled Enlarge/Reduce. Still, once learned, the commands are easy enough to remember. The only important command missing is Undo.

The Database section of the tutorial introduces *PicturePower*'s built-in database. Creating the database is a three-step procedure: First you define the fields, then you create a display form, and finally you enter records. When setting up the picture field, you can set the picture to any size and location, and you can have a maximum of 64 pictures per form—far more than you can reasonably fit on a single screen.

Once the database is created, you can access it in one of two ways: use the mouse-based commands to add, update, or look through the records or, if you don't have a mouse, view records without changing or adding them. This lets you set up workstations without mice for users whom you don't want messing with the database.

The *PicturePower* database lacks such features as sort and select, calculated fields, and custom reports. On the other hand, it uses *dBASE* file format and is designed to work along with *dBASE III Plus*. The manual's explanation for using *PicturePower* with *dBASE III Plus* is cryptic at best, but the actual procedure isn't difficult to program—once you understand it. PictureWare is aware of the problem with the manual and is currently writing an addendum to explain the procedure better.

■ The PicturePower Color System lets you crop the picture, shrink it, or otherwise manipulate it with edit commands.

EDITOR'S CHOICE

PC MAGAZINE

FACT FILE

PicturePower Color System
PictureWare Inc.
111 N. Presidential Blvd.
Bala Cynwyd, PA 19004
(215) 667-0880

List Price: PicturePower Color System, including *PicturePower* software, AT&T Targa 16 board, analog color monitor (RGB or composite), and RGB color video camera; $6,230. PicturePower Grey-Level System, including *PicturePower* software, digitizer and display board, black-and-white composite monitor, black-and-white composite camera, $3,200. *PicturePower* software only, $945.

Requires: 640K RAM, hard disk recommended, Microsoft or Mouse Systems Mouse, Hayes Smartmodem 1200 or compatible for communications option, DOS 2.0 or later.

In Short: The only complete off-the-shelf package in the group, the PicturePower Color System offers high-quality color pictures, image manipulation, a built-in, easy-to-use flat-file manager, and the ability to link your picture database with *dBASE III Plus*. Software not copy protected.

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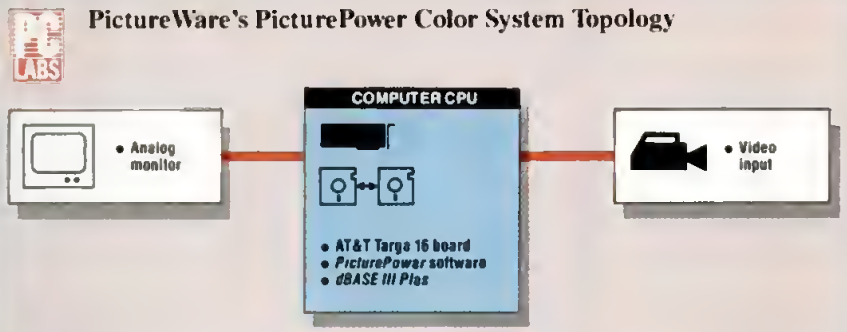

A complete PicturePower Color System color setup includes an RGB camera, an AT&T Targa 16 board, an analog monitor, and the *PicturePower* image capture and database software. The Targa 16 board functions both as the digitizer board for the video input and as the display board for the analog monitor. Although the *PicturePower* software's database lacks such features as sort and select, calculated fields, and custom reports, it uses *dBASE* file format and is designed to work along with *dBASE III Plus*.

CAPTURING PICTURES The third section of the tutorial introduces picture capture. You simply pick Capture from the main menu, followed by View, and the PicturePower System will show you a live shot of whatever the camera is looking at. The Targa board, with its 32,000 colors and 1/30 second capture time, yields good color fidelity with none of the lag that shows up with the Chorus Data Systems PC-Eye board.

While viewing the picture you aim, zoom, and focus, just as you would if you were videotaping. When you're satisfied with the picture, you Snap the shot by clicking a mouse button and it's frozen on-screen. You can then crop the picture, shrink it, or otherwise manipulate it with the edit commands. If you decide you don't like the shot, you can go back to View and take another picture. Besides RGB cameras, the system can use composite color cameras, composite black-and-white cameras, scanners, VCRs, and video compact disks as a picture source.

Once the picture is captured, you can save it to disk for later incorporation into a database record, or you can hold it in memory, go to the database, and create a record on the spot.

HUNGRY FOR SPACE The PicturePower System's only important drawback is its ravenous appetite for storage space. A full-screen image from the Targa board yields a 500K-byte file. The PicturePower System cuts down on this disk space by covering up part of the screen with its menu, but its largest-size picture still requires a 313K-byte file. A more reasonable quarter-screen picture uses up 84K, yielding about 120 pictures per 10 megabytes of storage.

To make matters worse, the PicturePower System keeps the entire picture database in a single file. This is not a problem with a hard disk, since the program can simply append a new picture to the file as needed. But with WORM drives, you must save the picture to hard disk first and then copy the entire file to the WORM drive. This complete file rewrite makes it impractical to use a WORM drive, since you'll quickly eat up the write-once cartridge. PictureWare is currently writing a WORM driver that will let the program write only the new picture each time.

The PicturePower System also has a communications module that offers file exchange features with no error correction and no data-compression capability. As such, the feature seems pointless. When transferring pictures, an error-correction protocol is essential to maintain picture integrity. And given the large size of picture files, a data-compression scheme would be welcome. Unless PictureWare adds these features to the module, you're better off ignoring it.

Despite its hunger for storage space, the PicturePower Color System is arguably the best in the crowd. It is certainly the only color system we tested that will let you easily create your own picture databases and design them to your own specifications. As it stands, the software program is good. When PictureWare revises it to minimize the storage space problem, it will be better.—**M. David Stone**

PICTUREWARE INC.

PicturePro-DB

PicturePro-DB, from PictureWare, bears a strong family resemblance to its sibling, *PicturePower*. Both software packages are built around an easy-to-use, flat-file database manager: both offer the same database features with nearly identical pop-up, mouse-driven menus; both create their data files in *dBASE III Plus* format, and both can be used along with *dBASE III Plus*.

The most important difference between

FACT FILE

PicturePro-DB
PictureWare Inc.
111 N. Presidential Blvd.
Bala Cynwyd, PA 19004
(215) 667-0880
List Price: $945
Requires: 640K RAM; hard disk recommended, Media Cybernetics' *Image-Pro* software; Microsoft Mouse; black-and-white or composite color monitor; black-and-white, composite color, or RGB camera. Imaging Technology PC Vision, PC Vision Plus, or Enhanced FG-100 board; AT&T Targa M8 board, Imagraph AGC board, or any of the Number Nine series boards; DataCube's IVG-128 or IVG-428 boards; Data Translation's 2851 or Optional 2858 boards; Comtel /3M board; or Parallax 1280 board; DOS 2.0 or later.
In Short: Designed primarily for those who are already using *Image-Pro* to create and process black-and-white pictures, *PicturePro-DB* offers its own picture capture feature and the ability to manage your pictures either with its own built-in database or by linking to *dBASE III Plus*. Not copy protected.

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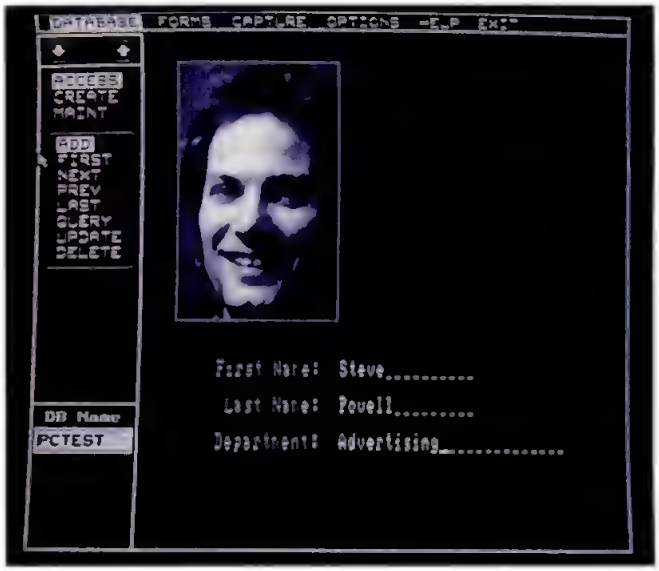
CIRCLE 744 ON READER SERVICE CARD

the two is that *PicturePower* is a standalone program complete with its own image-editing features, while *PicturePro-DB* is designed to work with *Image-Pro* image processing system software from Media Cybernetics. In addition, the version of *PicturePower* tested here creates a color picture database, while *PicturePro-DB* is currently available only for the AT&T Targa M8 board, yielding black-and-white images with 256 shades of gray.

The popular *Image-Pro* is limited to image capture and processing. It stores each image in a separate DOS file and leaves it up to you to keep track of the files. *PicturePro-DB* works as a separate module that you can call from within *Image-Pro* to turn a scattered collection of images into an orderly database.



PicturePro-DB *is designed to work with* Image-Pro *image-processing software, from Media Cybernetics. But it bears a strong resemblance to its standalone sibling,* PicturePower. *The two share the same logical design and the same database features.*

INSTALLATION Hardware setup for the Targa M8 is essentially the same as for the Targa 16: set the DIP switches on the board, plug the board into your computer, and plug the video camera and analog monitor into the board. The cable connecting the Targa M8 to the camera also has a curious second cable emerging from the connector on the Targa end. You can plug this cable into a CGA's output to use the analog monitor as a display for standard DOS programs. (The pass-through linkage won't work with an EGA.)

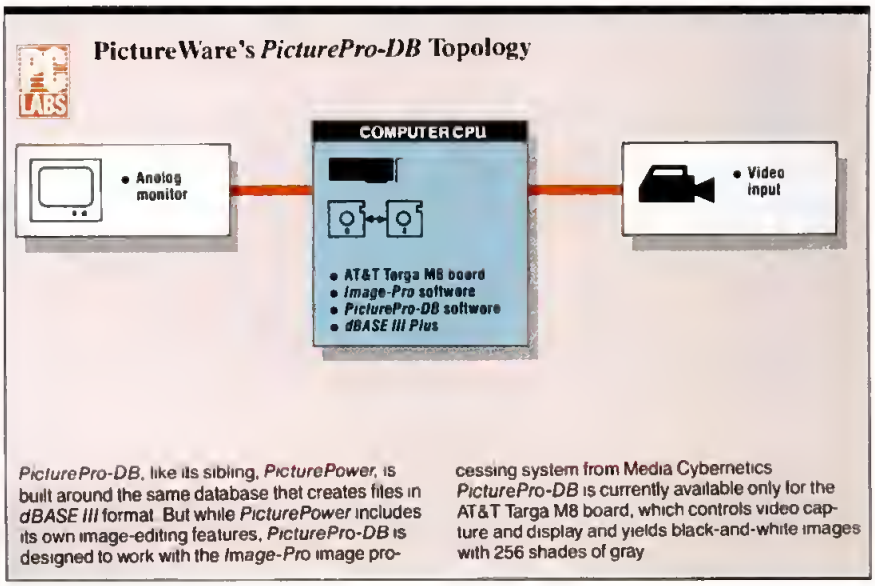
I used a JVC RGB camera for input, but any RGB, composite color, or black-and-white camera will do, as will VCRs, videodisk players, and any other source of analog video signals. For output, I used a Sony PVM-1271Q monitor, but here again, you can use any composite color or black-and-white monitor.

For this review, PictureWare supplied a preliminary version of the *PicturePro-DB* manual. It is similar to the *PicturePower* manual in many ways, but it fails in its installation instructions. If you try to install an entire system at once—hardware and software—you'll find that the *PicturePro-DB* manual lacks *PicturePower*'s useful overall instructions. The section on installing hardware reduces to "follow the . . . instructions . . . in the user guide for your graphics display board, your pointing device, your monitor, and your video camera." The *PicturePro-DB* instructions for installing *Image-Pro* tell you to create an IMAGEPRO subdirectory and "follow the installation instructions in the *Image-Pro* manual." In fairness, this approach makes sense: *PicturePro-DB* runs as a module under *Image-Pro*, and the overall instructions should logically be in the *Image-Pro* manual. Unfortunately, the *Image-Pro* manual doesn't do the job either.

DEALING WITH IMAGES *Image-Pro* is sophisticated but difficult to learn. It can capture an image, then let you change contrast, crop, scale, posterize, rotate, and apply filters to selectively enhance edges, vertical lines, or horizontal lines. It also includes the paint program, *Dr. Halo*, under the name *HALOVision*. With *HALOVision*, you can add text, cut and paste, rotate sections of the picture, draw circles, lines, or boxes, and even print the image.

Image-Pro uses a mouse or other pointing device for both image editing and for the point-and-shoot menus. But although the menus are easy enough to use, their meanings are not immediately obvious.

Even the tutorial lacks useful explanations. An impressive demonstration leads you through taking a virtually featureless



PicturePro-DB, like its sibling, *PicturePower*, is built around the same database that creates files in *dBASE III* format. But while *PicturePower* includes its own image-editing features, *PicturePro-DB* is designed to work with the *Image-Pro* image processing system from Media Cybernetics. *PicturePro-DB* is currently available only for the AT&T Targa M8 board, which controls video capture and display and yields black-and-white images with 256 shades of gray.

picture and following some cookbook instructions to produce a recognizable X ray of a hand, but at no point does the tutorial explain what you are doing or why.

CREATING THE DATABASE *PicturePro-DB* installs as a user module under *Image-Pro*. You can run it from the *Image-Pro* main menu by choosing User Modules, then *PicturePro-DB*.

The program looks and acts like *PicturePower* in almost every way, with the same logical design and the same database features, complete with definable picture size and multiple pictures for each record. The only important functions missing are the picture-editing features, on the grounds that *Image-Pro* already has all the editing capability you'll need, and the communications feature, which isn't very useful anyway.

The *PicturePro-DB* tutorials follow the same approach as the *PicturePower* tutorials, showing you how to create and use the built-in database. The chapter on using *PicturePro-DB* with *dBASE III Plus* seems almost identical, with the same lack of information. If you plan to use the program with *dBASE*, expect to call PictureWare technical support for help.

Capturing images with *PicturePro-DB* is also the same as with *PicturePower*. When adding a record to your database, you can either capture a picture at that moment or read a picture from disk. The difference, of course, is that with *PicturePro-DB* you can read a picture created with *Image-Pro;* with *PicturePower*, you can't.

Because you can capture a picture directly with *PicturePro-DB*, you can create your picture database without using *Image-Pro* at all. In fact, you can load *PicturePro-DB* from the DOS prompt and use it as a standalone program. Unfortunately, you cannot use *PicturePro-DB* without having *Image-Pro* on the disk. *PicturePro-DB* makes use of the Targa M8 device driver that comes with *Image-Pro*. It has no driver of its own, and Media Cybernetics will not supply the driver separately.

Because the M8 works with black-and-white pictures, *PicturePro-DB* images absorb relatively little disk space. The full-screen image in *Image-Pro* is 248K bytes. As with *PicturePower*, *PicturePro-DB* cuts down on this by covering up part of the screen with its menu, yielding 190K per image. A quarter-screen image is about 65K, yielding about 153 images per 10 megabytes.

As is the case with *PicturePower*, *PicturePro-DB* keeps all its pictures for any given database in one file. This creates the same problem that *PicturePower* has with WORM drives, in which you must save the picture to hard disk first, then copy the entire file to the WORM drive, quickly eating up the write-once cartridge. According to a PictureWare spokesman, a WORM driver will soon be available to solve that problem.

TARDY STORAGE One minus for *PicturePro-DB* is the picture storage time. When capturing an image from within the program, picture capture is essentially instantaneous. However, when you accept the image to be added to your database, the program first blanks the screen, rewrites the image to the database form, and then saves it to disk.

For a full-screen image, the actual storage time, judging by disk access time, is about 9 seconds, but the rewrite is 19 seconds, yielding a practical storage time of nearly half a minute. For quarter-screen images, the storage time is 5 seconds of rewrite plus 5 seconds of disk access. According to a PictureWare spokesman, much of this rewriting time disappears if you are using an EMS board in your system. (PictureWare recommends 1 megabyte.) Retrieval times run to a more-acceptable 8 seconds for full-screen images and 2.9 seconds for quarter-screen images.

Also on the minus side, retrieved pictures occasionally showed random white specks, like a kind of digital dandruff. And error handling includes at least one oversight. I ran out of disk space while saving a file and was given the message "Disk full. Release space before continuing." Then the program hung, forcing me to reboot and lose the picture I had just captured.

The *PicturePro-DB* supplied for this review was a beta-test version. A look at the help screens showed that they were lifted wholesale from *PicturePower*. The main help screen mentions *PicturePower* and talks about the communications option, which is not in *PicturePro-DB*. A PictureWare spokesman assured me that the known problems will be fixed before the program is released.

But even with these flaws, *PicturePro-DB* does its job reasonably well. If you're already using *Image-Pro* or need its picture-editing features, *PicturePro-DB* is the obvious choice for keeping track of your pictures.—**M. David Stone**

ROYAL RECOVERY SYSTEMS INC.

Instant Image Talk Workstation System

The Instant Image Talk Workstation System, from Royal Recovery Systems, stands out from a pack of individualistic image databases for its unique approach. While the other software packages treat

PC MAGAZINE FACT FILE

Instant Image Talk Workstation System
Royal Recovery Systems Inc.
P.O. Box 1468
Plainfield, NJ 07061
(201) 753-2835

List Price: Instant Image Talk Workstation System, including video player, decoder, and *Instant Image Talk* software, $8,000 before Sept. 30, 1987; $9,000 after Sept. 30, 1987; including recorder/player, decoder, and software, $16,000 before Sept. 30, 1987; $17,000 after Sept. 30, 1987. Instant Image Talk Production System, including Panasonic TQ2026F recorder, EECO encoder, EECO decoder, and software, $56,000 before Sept. 30, 1987; $57,000 after Sept. 30, 1987. Videodisks, $145 each.

Requires: 640k RAM, hard disk recommended, composite color monitor, video input device (for Production System), one serial port for image database, second serial port needed for optional audio feature, DOS 2.0 or later.

In Short: Clearly the Mercedes of picture database systems, the Instant Image Talk Workstation System has room for 24,000 pictures on a videodisk and can optionally add sound to the pictures as well. Alas, the price challenges that of the Mercedes as well—starting at $8,000 for the software plus videodisk player and quickly going up from there with each customization or option. Software not copy protected.

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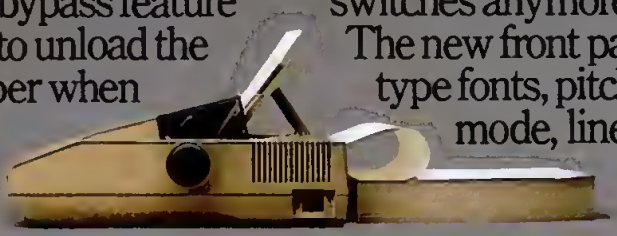

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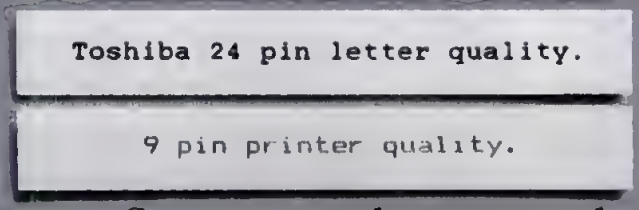

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pictures as a special kind of field within a standard, field-oriented database, the *Instant Image Talk* software throws out the whole concept of fields. Instead, it allows you to create a database of pictures annotated with keywords.

KEYWORDS By using what Royal Recovery Systems calls an associative database, *Instant Image Talk* lets you store pictures and associate any number of keywords with each one. You can then retrieve the pictures on the basis of individual keywords or combinations of keywords. Because there are no fields, you don't have to keep track of which keywords go in which fields. To facilitate searching for a picture, the program can show you an alphabetized list of keys on your computer screen, starting with any arbitrary letter. If you are assembling a picture library in which you will want to retrieve pictures primarily by keywords, it offers a clear advantage.

■ The Instant Image Talk Workstation System offers by far the fastest storage and retrieval times of any of the color systems.

Instant Image Talk also allows for applications that require fields, or something like them. When you tell the program to associate keywords with a picture, it presents a screen with room for ten keywords. You can enter the words in any order, and you can keep filling additional screens until you run out of keywords. But those who want the same kinds of keywords attached to each picture can conveniently give each of the ten spaces for keywords a name. *Instant Image Talk* does not store records as such. Instead, it offers an "infobox." If you toggle the infobox on while viewing a picture, the program will show you the first ten keywords associated with that picture and will allow you ten lines of 60 characters each for comments. You can type the comments or change them at any time when viewing the picture. In the version reviewed, the infobox is a fixed size, taking up 800 bytes per picture. (You can also obtain customized versions of the program from the manufacturer.) The infobox and other software screens show up on your computer screen, while pictures show up on an analog monitor.

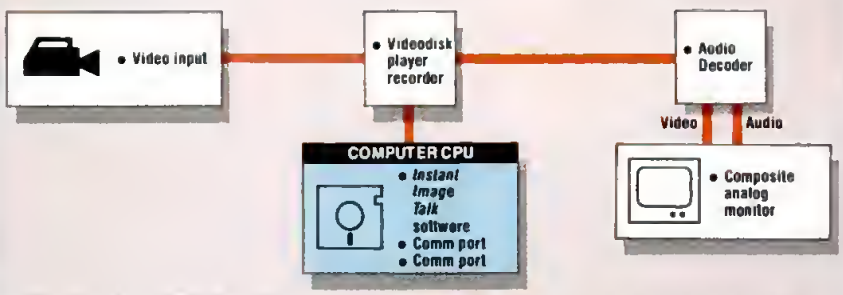
The software also offers a few additional tricks: for instance, it can join pictures in any order for slide-show presentations. You can then play back the presentations at any speed you select.

Because the Instant Image Talk *software stores and displays pictures as analog images, image quality depends entirely on the video recorder and camera and the analog monitor used. The recorder resolution is 300 lines, not quite broadcast quality (512 lines).*

HARDWARE The Instant Image Talk Workstation System's uniqueness extends to its hardware. All of the other systems operate on the same basic principles. Conventionally, video input goes to a capture board, which digitizes it for storage on a hard disk or an optical disk WORM drive. The display board, which is sometimes consolidated with the capture board, recalls the digitized image, processes it into analog signals, and sends it to an analog monitor.

The Instant Image Talk System, however, skips the digitized images. Instead, the video input goes directly to a Panasonic TQ2026F videodisk recorder/player,

Royal Recovery Systems' Instant Image Talk Workstation System Topology



Unlike other picture database systems reviewed here, the Instant Image Talk Workstation System does not digitize images. Instead, the video input goes directly to a Panasonic TQ2026F videodisk recorder/player, where it is captured directly as an analog image. Once you've saved the image, you can play it back and send it to a composite analog monitor. You attach the recorder/player to your computer through a communications port. In addition, you can store sound along with the pictures, or, instead of an image, you can put sound into any of the videodisk's 24,000 frames. The *Instant Image Talk* software is an associative database that lets you store pictures and associate keywords with them.

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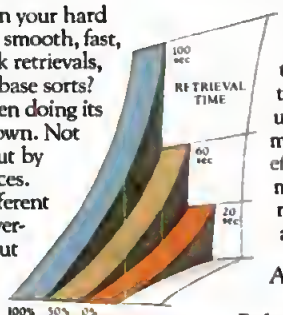

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where it is captured directly as an analog image. Once you've saved the image, you can play it back and send it to a composite analog monitor.

You attach the recorder/player to your computer through a communications port. You can take and retrieve pictures either by giving commands to the recorder through the comm port or by using the recorder's front-panel controls.

Because the system relies on the Panasonic videodisk recorder, the picture quality is determined entirely by the camera, the monitor, and, of course, by the recorder itself. The recorder resolution is 300 lines (there are no pixels in an analog picture), with essentially unlimited colors. The picture quality is not quite broadcast quality (512 lines), but the result is at least as good as, if not better than, digitized images from the much-praised AT&T Targa 16.

ADVANTAGES Through bypassing the need for digitizing and undigitizing images, analog technology offers some notable advantages. The Instant Image Talk System offers by far the fastest storage and retrieval times of any of the color systems. Royal Recovery Systems claims less than one-half second for both storage and retrieval—a claim that seems reasonable.

Another noteworthy feature is the number of pictures that the system can handle. Each 8-inch videodisk can hold 24,000 full-screen images. To get the same number of full-frame pictures from a Targa 16 board, you'd need more than 9,800 megabytes of storage at 410K bytes per image. Even with quarter-frame pictures and assuming a 10:1 compression scheme, as with the ALICE board, you would still need a hefty 240 megabytes.

What's more, the Panasonic videodisks are removable, so you can create multiple volumes, with 24,000 pictures on each. And you can stack playback units on top of each other so that more than one disk is online at a time.

Yet another feature of these videodisks is that you can store sound along with pictures—the "Talk" part of the Instant Image Talk System. Instead of an image, you have the option of putting 10 seconds of compressed audio into any of the 24,000 frames. The encoder system for putting the still-frame audio sound on the disks costs roughly $30,000, which means that you might want to create audiotapes and send them out for processing.

Once you've added the audio, you can link up to four sound frames to each image frame, resulting in 10 to 40 seconds of sound per image. The software will let you leave the sound off or set the system to automatically play the sound back when you call up the image. Alternatively, you can use the sound frames to create a strictly audio database—for tracking the changing sounds of whale song, perhaps, or maintaining a database of birdcalls.

HIGH-COST POWER The basic Instant Image Talk Workstation System package costs $8,000, and that covers just the Panasonic player and the *Instant Image Talk* software ($16,000 for the recorder/player plus software). Video cameras, monitors, and cables are all extra, adding anywhere from $1,000 to $8,000 to the cost of the system. Add in the cost of the computer, and you're likely to pay more than $20,000 for a complete system. Sound decoders cost an additional $3,000.

One annoying limitation, especially given the price of this system, is how little you can modify it on your own. It's not that the system isn't flexible; it's just that Royal Recovery Systems doesn't give you the tools you need to make the changes. For instance, a simple installation program can change the names attached to the key word entry screen, change the videodisk player port between COM1 and COM2, and choose between a color and a monochrome display adapter. But Royal Recovery Systems doesn't supply the install program. To change any of these options, you have to go back to the company.

■ The Instant Image Talk Workstation System lets you link up to four sound frames to each image frame, resulting in 10 to 40 seconds of sound per image.

Royal Recovery Systems will supply any number of additional customizations. For example, the system as tested would not work with *dBASE III*, but I was assured it could be customized to do so. According to a Royal Recovery Systems spokesman, it could even be customized to transfer an image to a Targa 16 board, let you modify the image with AT&T's *TIPS* package, and then save the image on the videodisk recorder. All custom work is done for an hourly charge.

The cost of this system will certainly keep it out of reach for some markets, but its features put it way ahead of most other picture databases. The sheer number of images per videodisk, combined with the associative nature of the database, make this product nearly ideal for large picture collections. If you have the budget for it, the Instant Image Talk Workstation System is probably the system you want.

—M. David Stone

M. David Stone is a contributing editor of PC Magazine.

PC MAGAZINE EDITOR'S CHOICE

• **PicturePower Color System**

Although each of the packages reviewed here is better than the others for at least one specific application, the PicturePower Color System is the clear Editor's Choice. Its high-quality pictures, well-designed database, and fully integrated manual make it the only picture database designed for users rather than systems developers. Additional features, such as image editing, make it that much better. The only drawback is the large amount of space needed for the image files, and that will largely disappear with the upcoming support for the ALICE compression board.

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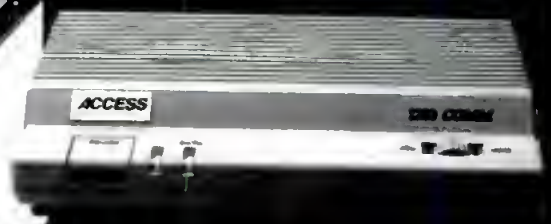

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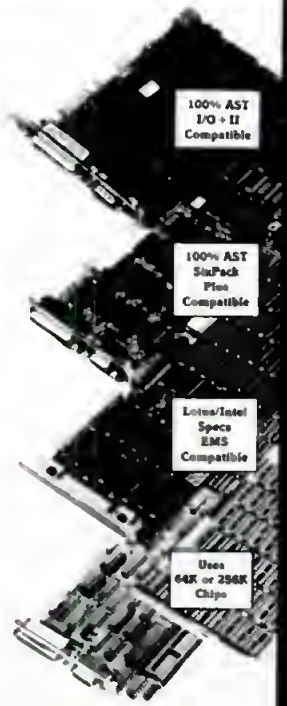

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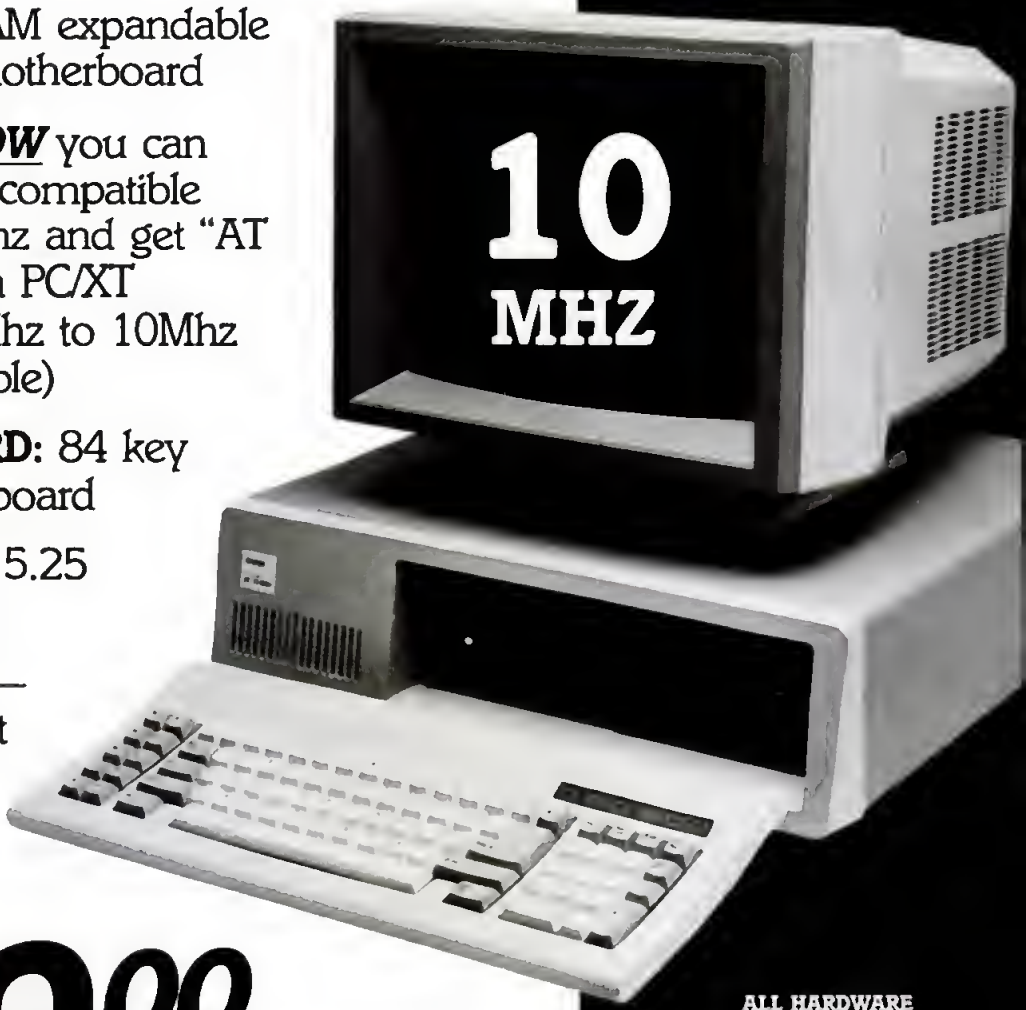

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BACK FROM THE BRINK:

File Recovery Software

Yes, Virginia, there is life after death for disk files—if you have good file recovery software. Here are 11 of the leading DOS enhancement programs that let you unremove, unformat, unscatter, and unerase when you most need to.

After eight tries, you'd think IBM would get it right. Yet though DOS has gone from Version 1.0 to Version 3.3, it still lacks necessary—even lifesaving—features.

The need to overcome the shortcomings of DOS has spawned an entire industry of enhancement. You can currently buy commercial utility programs that recover erased files, resurrect data after inadvertent disk formats, find ailing bytes in both RAM and on disk, speed up disk access, locate text strings and files anywhere online, and even move subdirectories with all their files in one fell swoop.

The Norton Utilities are the best-known of this type of package. Competitors number nearly a dozen, and their features, most notably the ability to recover from an accidentally reformatted hard disk, have spurred Norton to upgrade his package.

These programs thrive because DOS seems designed to work only in a world where no one makes mistakes. The operating system offers no way for you to fix unforeseen problems. Perhaps the analysts who designed DOS figured that people don't change their minds or don't accidentally press the wrong keys, blowing away files, directories, and whole disks. Consequently, nearly all DOS-enhancement packages can undo erased files.

File Recovery Software: Summary of Features

(Products listed in ascending price order)

	The Nibbler	PC Tools	DS Recover	Power Tools	SafetyNet	Disk Explorer	Disk Toolkit	Mace Utilities	The Norton Utilities, Version 4.0	The Brown Bag Utilities	The Norton Utilities Advanced Edition
List price	$29.95	$39.95	$49.95	$55.00	$59.95	$75.00	$75.00	$99.00	$100.00	$129.95	$150.00
Unerases after the fact	●	●	●	●	○	●	●	●	●	●	●
Before-the-fact erasure protection	○	○	●	○	●	○	○	○	○	○	○
Recovers directory	●*	●	●	●	●*	●*	●*	●	●	●*	●
Unformats	○	○	●	○	●	○	○	●	○	○	●
Optimizes disk operation	○	○	○	●	○	○	○	●	○	○	●
Byte-level editor	●	●	○	●	○	●	●	●	●	●	●
Gives system information	○	●	○	●	○	○	○	●	●	●	●
Tests disk integrity	○	○	○	○	○	●	●	○	●	●	●
Provides disk map	●†	●	○	●	○	○	●	●	●	●	●
Memory resident	○	●	●	●	●	○	○	○	○	○	○
Changes file attributes	●	●	○	●	○	●	●	●	●	●	●
DOS functions	○	●	○	●	○	○	○	○	○	○	○

PC –Indicates Editor's Choice ●–Yes ○–No

*The removed directories can be recovered, but not with the same facility as erased files. Such recovery may require the use of byte-level editing.

†*The Nibbler* will map the location of individual files on floppy disks only.

UNDELETING More than 5 years ago, *The Norton Utilities* made the world aware that disk files did have life after death and gave the power of file resurrection to the common man. The *Norton* package and all of the many imitators and innovators that have followed exist because the operating system is lazy. When you erase a file, it doesn't remove the contents from disk. Instead, it remembers the location of the erased file but changes nothing until it is forced to write over that location for some other reason.

When a file is "erased," DOS simply marks the file's directory entry (to indicate that it can be reused later) by changing the first character of its name to the hexadecimal character E5. Likewise, it revises all the file allocation table (FAT) entries to show that they are available. Other than that, the file data is all safe and intact.

Unerasing is just a matter of putting the proper identification marks back into place. Although you could make the necessary changes using DOS's DEBUG facility, as with many operating system functions, such tasks are easier said than done, at least manually. The DOS-enhancement file recovery or unerasing utilities automate the process and make it a simple matter of coming up with a new first letter for the filename.

Although an erasure destroys only a few bytes of information, a portion of that loss is vital. The bytes in the FAT tell DOS where each piece of the file (or cluster) is stored. Without the guidance of the FAT, DOS and the file recovery program can only guess where the data is hidden.

If only one file has been erased, finding its data is simply a matter of finding holes in the rest of the information stored on the disk. Automatic programs can handle this chore almost instantly, requiring only that you supply the missing first character from the filename.

When multiple files have been erased, however, locating clusters gets chancier. Consequently, most recovery utilities include a manual mode that lets you look at the data in various disk clusters so that you can determine whether it belongs in the file to be reconstructed.

Given DOS's straightforward organization of disk clusters, one file recovery package is unlikely to be more or less successful in its given task than any other. The differences between commercial products come down to ease of use, options, and auxiliary functions.

DATA INSURANCE A new type of unerasing program is appearing on the market, the before-the-fact or insurance-style file recovery utility. Conventional unerasing is an after-the-fact (or after-the-error) procedure: you don't call upon the program to do anything until your luck runs out. The data insurance programs don't wait. They store the FAT information and first character of the filename *before* you have a chance to lose it. They also prevent DOS from touching disk-based data even after it is erased.

Because these programs preserve all the information about erased files, they guarantee successful recovery of any erased file completely intact with no manual intervention. As penalties, these programs require you to have foresight (you've got to run them every time you start your PC to have protection), and they impose housekeeping duties on you to ensure that your disk doesn't fill up with the data left over from erased files.

UNREMOVAL Another new function appearing in file recovery packages is the ability to unremove subdirectories, on both before- and after-the-fact bases. Recovering a lost subdirectory is hardly more

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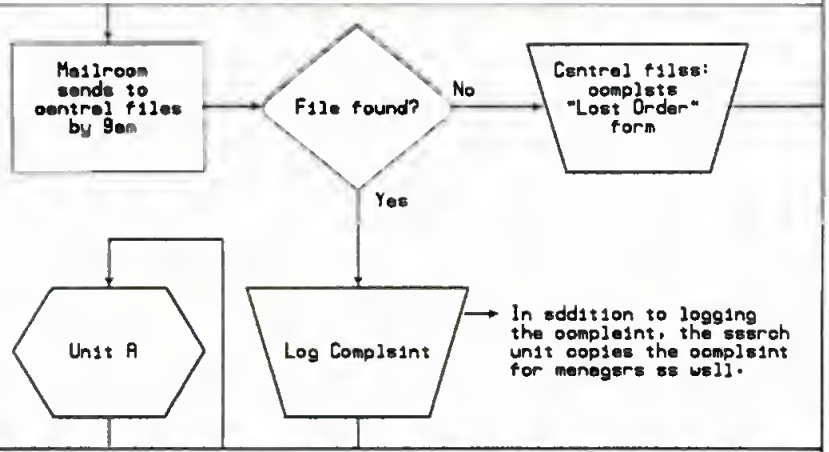

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■ Unformat programs keep a duplicate copy of your disk's FAT and root directory in a special place on the disk.

arduous than rebuilding a file because DOS treats subdirectories as little more than files. In fact, since most subdirectories only require a single cluster of disk space, after-the-fact utilities have a better chance of completely restoring them than a lengthy data file.

Of course, after you restore a subdirectory, you'll have to recover all the files listed in it individually—remember, DOS won't permit you to remove a directory until after you've deleted every one of the files that it contains.

UNFORMATTING Another new feature that is appearing in many add-on utility packages is the ability to recover from inadvertently formatting a disk. The underlying principle is the same for all, a before-the-fact protection scheme that works because the latest versions of DOS do not actually overwrite data on the disk during a format. In all versions of PC DOS since 2.0 (and in many but not all versions of MS-DOS), the format procedure only clears out the FAT and main directory on the disk.

What's left after the format procedure is complete is an electronic jigsaw puzzle: all of the pieces are there, but neither you nor DOS has any idea of how to put them back together.

Unformat programs work by keeping a duplicate copy of your disk's FAT and root directory in a special place on the disk. As insurance, you must run a special program that puts that information into that special file every time you start up your system—or even more often.

If you're the only person who uses your computer, unformat insurance protection is probably unnecessary with DOS, Ver-

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sion 3.2 or later. These latest DOS revisions not only give you a second chance to wake up and stop the formatting process (by querying you before they start), but they also require you to type in the volume label of the disk to be formatted. However, if devious ne'er-do-wells (a synonym for coworkers, generally) have access to your PC, one of these programs could protect you from their foulest deeds.

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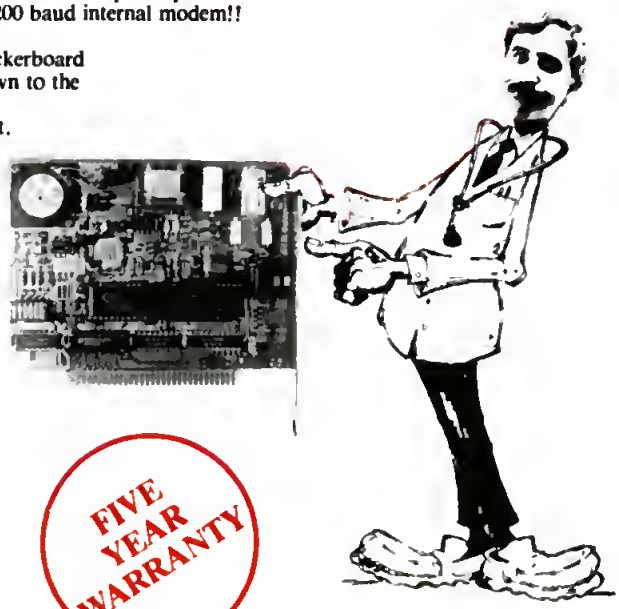

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At least one utility package—the *Mace Utilities*—actually tries to help you recover from the tabula rasa of an accidentally formatted disk after the fact. However, it requires you to regenerate all filenames and link the clusters of all the files on the disk manually. The chances of complete success are much better with a well-ordered disk—one in which all the clusters of every file are contiguous—than with one in which file clusters are randomly scattered. (True after-the-fact recovery may be possible, but also extremely expensive, through outside service organizations that have special analog equipment that can detect minute residual magnetism in your disk directory and FAT.)

UNSCATTERING If you use your disk at all, some scattering of clusters is inevitable. Not only do dispersed file clusters make recovery more difficult when a file gets erased, scattered file clusters can also slow your system down, making it needlessly time-consuming to access large files. Consequently, many DOS-enhancement packages now include disk optimization programs that simply make each file's clusters contiguous.

From these beginnings, DOS-enhancement programs wander off in their own directions and offer their own distinct combinations of features. Many include byte-level editors that allow you to view and alter any byte anywhere on any disk. With a byte-level editor, you can modify text files, programs, and even directory entries with ease.

Other enhancement packages combine as many utility functions as will fit on a disk, duplicating DOS (but with added versatility and facility) and adding their own magical touches.

Here's a look at 11 of the leading DOS-enhancement packages, all of which share the ability to revive your erased files and your peace of mind. The reviews are arranged alphabetically by product name.

The Brown Bag Utilities

From humble beginnings as a shaky file recovery system, *The Brown Bag Utilities*, Version 4.0, have matured into a useful and powerful product. The $129.95 package from Brown Bag Software extends the

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ability to unerase files to include recovering data from damaged and nonstandard disks. In addition, it has disk and RAM diagnostics and byte-level editing.

The Brown Bag Utilities are essentially menu driven, linked by a single startup batch file. You cannot access individual functions from the command line. The two large modules of the package are the disk utilities and RAM test procedure (which can be individually executed without the initial batch file).

The latter program is the more straightforward. It tests system memory—base (the 640K bytes of DOS memory), extended, and expanded RAM—much more stringently than does the PC's power-on-self-test (POST) procedure. Often the *Brown Bag* diagnostics will turn up errors in systems that pass the BIOS test with ease. The test can help you find marginal chips so you can replace them before they fail at some inopportune moment. (Is there ever an opportune moment for a memory chip to fail?)

The *Brown Bag* disk utilities are united by a crowded, full-screen menu from which you select the various functions using number keys. Each menu selection presents several subselections to choose from.

You can handle file recovery automatically or manually. Automatic recovery works like most other systems, merely requiring you to specify a replacement initial character for the name of the deleted file.

Manual recovery is fully prompted. The program presents its best guess for erased clusters for your approval. You can either add the clusters to a list to be saved or venture onward to the next cluster, perhaps limiting the selection to only those containing ASCII text. The program prompts you to stop after you have selected enough information, but allows you to seek and collect more data should you want to. When you're done, pressing a key writes the necessary changes to disk.

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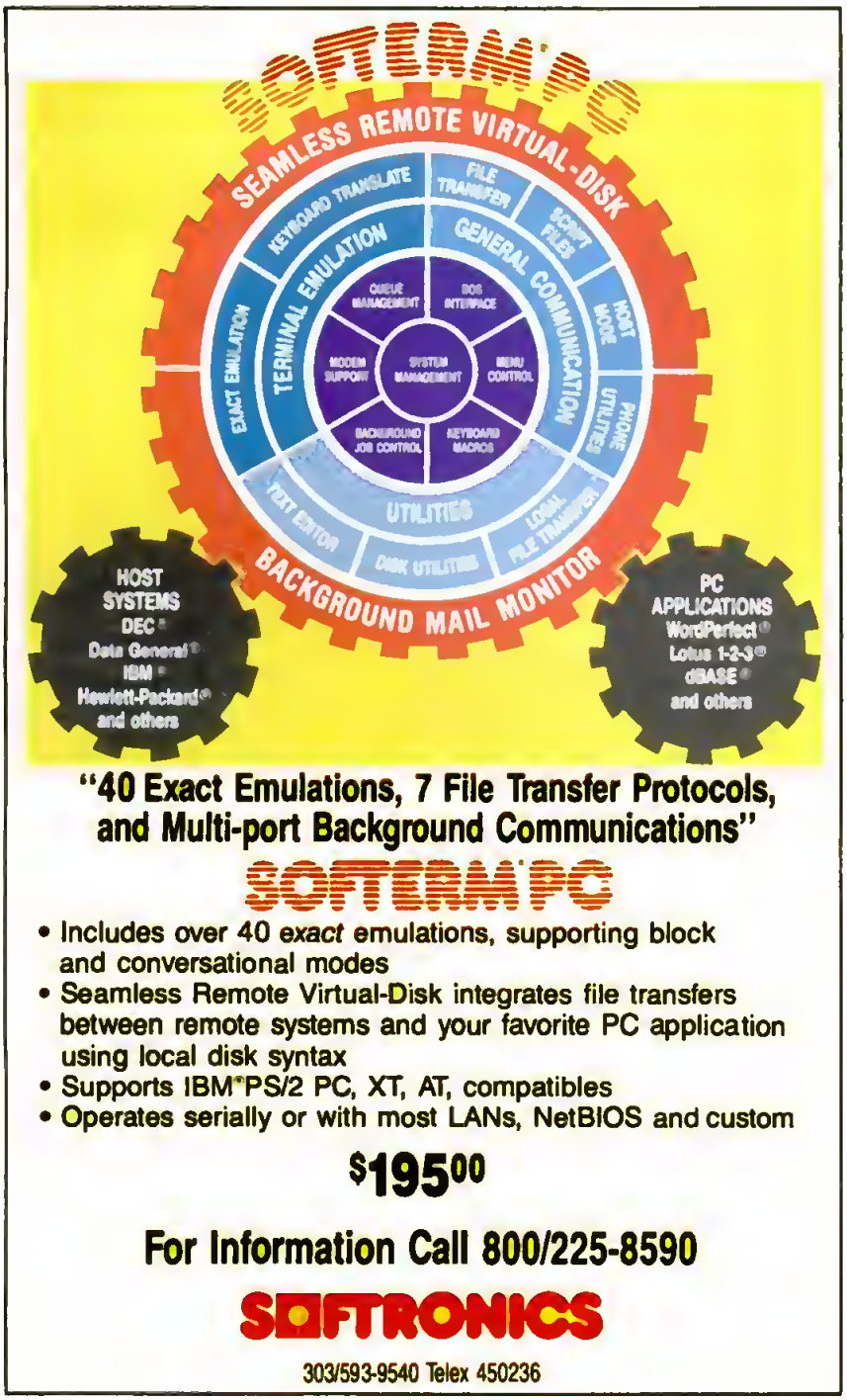

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The *Brown Bag* File Recovery Program also attempts to read non-DOS and damaged disks, allowing you to transfer your data to more suitable media. It cannot read a sector with a cyclic redundancy check (CRC) error, however.

Included in the package are several security options, including those that wipe out all data on any disk, wipe out only previously erased data, and check the integrity and readability of a disk.

A byte editor allows changing any byte inside or outside of files. In addition, the utilities allow easy alteration of file attributes so that you can hide or unhide files or mark them read-only. Although *The Brown Bag Utilities* do not explicitly restore removed directories, you can use the byte-level editor to accomplish that.

The evaluation copy of *The Brown Bag Utilities* also included a separate system speedup program called *Doctor DOS* that works by replacing several BIOS routines, primarily those involved with video and keyboard interrupt handling, with faster versions to make your system more responsive. But *Doctor DOS* doesn't actually make your PC compute faster.

The enforced menu structure of *The Brown Bag Utilities* makes them easy to use, and their damaged-disk recovery ability makes them powerful. Although other programs have more options and abilities, what these *Brown Bag Utilities* do, they do well.

Disk Explorer

The $75 *Disk Explorer*, from Quaid Software, is designed to be exactly that, a program that helps you investigate what's written on your disk. Along the way, you can add, alter, and delete just about anything you want with its byte-level editor. Although many of the features of *Disk Explorer* will only appeal to those with insatiable curiosity or people who like to tinker with data storage techniques, built into the program are two very helpful and easy-to-use explicit file recovery features.

One file recovery method is completely automatic and very easy to use. Once you select File Recovery from the opening menu, the program prompts you for the full name of the file that you want to recover. Type it in, press Enter, and *Disk Explorer* searches through all the subdirectories on your disk looking for erased files that might match the name you chose. When the program finds a likely candidate, it packs the newfound data into a memory buffer. Before saving it to disk, it prompts you for confirmation.

Manual file recovery is more complex, but not overwhelming. *Disk Explorer* lists all files and subdirectories on the disk, including erased files and removed subdirectories, in one long display. From that list you can choose a likely candidate for re-

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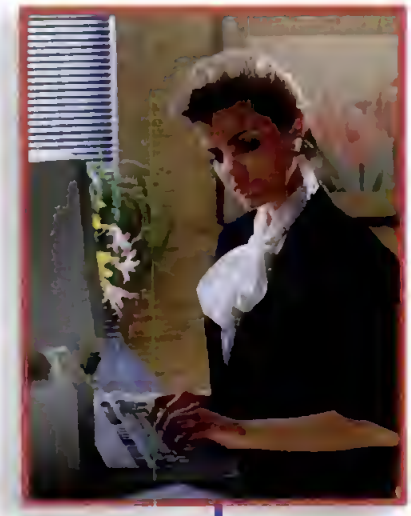

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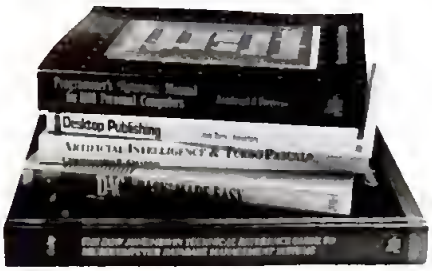

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CIRCLE 747 ON READER SERVICE CARD

■ FILE RECOVERY

PC MAGAZINE FACT FILE

Disk Explorer

Disk Explorer
Quaid Software Ltd.
45 Charles St. East,
3rd Fl.
Toronto, Ontario,
Canada M4Y 1S2
(416) 961-8243
List Price: $75 (U.S.)

Requires: 128K RAM, one disk drive, DOS 2.0 or later.

In Short: A program aimed at revealing the innermost secrets of disks, DOS and otherwise, that includes both manual and automatic file recovery and byte-level editing. Not copy protected.

CIRCLE 620 ON READER SERVICE CARD

covery. Simply press Enter and you can view the contents of its first cluster. You press a function key to place the displayed data into a memory buffer.

Another key press advances you to the next likely cluster. You can look at it, save it, or go on to the next. After you've accumulated all the data you need, another key press writes the information you've chosen to disk.

Beyond file recovery, *Disk Explorer* can give you a trove of information about the disks you use. One display, for instance, shows you the format of a floppy disk. On ordinary disks, that's pretty boring stuff, but it can be interesting (and helpful) with damaged, non-DOS, or copy-protected disks.

Disk Explorer also allows you to edit sector data and write it directly to disk. In the process of writing individual sectors, you can include cyclic redundancy check (CRC) errors, weak bits, and similar aberrations to create your own copy-protection system or duplicate someone else's. *Disk Explorer* also allows you to format a bad track so that it looks OK to DOS, should you be inclined to do such things.

Compared with the raft of products that clone other products, *Disk Explorer* is refreshingly original. However, commands are also somewhat unusual, involving combinations of left-hand (or top row) function keys, the numeric/cursor keypad, and alphanumeric keys. Fortunately, all the necessary strokes are described, albeit

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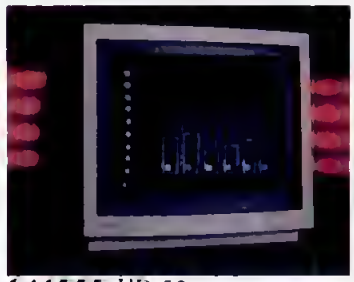

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CIRCLE 221 ON READER SERVICE CARD

briefly, with on-screen legends.

Despite its immense power, the most useful aspect of *Disk Explorer*, and the best reason for buying it, is its file recovery abilities.

Disk Toolkit

Built around a byte-level editor, the $75 *Disk Toolkit*, from Morgan Computing Co., is a single powerful program that can read and edit any byte on any disk. That ability alone is enough to unerase files; however, the compact program also includes a dedicated file recovery function to make such chores easy.

The *Disk Toolkit* editor permits both file-level and sector-level viewing, altering, and copying as well as peering into memory, rattling bytes around, and copying them to disk.

Compared with other utility packages, *Disk Toolkit* is extremely powerful for its size. It requires only 24K bytes of memory but gives menu control to nearly all the functions of DOS DEBUG and even incorporates a full-screen editor.

The trade-off for code size seems to be appearance. *Disk Toolkit* doesn't look as sexy or elegant as some of the other full-featured packages, but it handles its appointed functions just as capably. Its displays are much like those of DEBUG—multiple 16-column rows of hexadecimal bytes on the left with the corresponding ASCII representation on the right—but you can move around easily by pressing cursor keys instead of giving DEBUG's single-letter commands.

The *Disk Toolkit* editor can alter bytes in memory or on disk. Those in memory are changed immediately. On disk, changes are stored temporarily in a memory buffer and are written only after you confirm your intentions, helping you avoid permanent errors.

Disk Toolkit also includes a complete extended directory display that also serves as a front-end for its file recovery system. It displays all directory entries, both valid and erased (or removed). To recover files,

PC MAGAZINE FACT FILE

Disk Toolkit
Morgan Computing Co. Inc
P.O. Box 112730
Carrollton, TX 75011
(214) 746-5335
List Price: $75
Requires: 128K RAM, one disk drive, DOS 2.0 or later.
In Short: A quick-working compact program that offers menu-driven file recovery combined with byte-level editing and intimate system control. Not copy protected

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you simply select the proper entry, give a new first letter to the file or directory name, and let the program automatically select clusters. The tool kit can also prompt manual cluster selection.

The program also includes three error-checking routines; two merely check for errors on the sector level and across the whole disk, while a third verifies the whole disk and then allows you to mark any bad clusters so DOS will not try to use them (with potentially disastrous results).

The labels used for eliciting the *Disk Toolkit* functions are mostly carried over from DEBUG terminology and are rather complex as a result, but using the program is a breeze—in part because it's fast. Functions seem to be carried out instantly.

Disk Toolkit appears aimed at more-experienced users. For instance, to read a sector, you must specify the drive, track, side (head), starting sector, and number of sectors to be read.

If you want intimate but easy control over your hardware with file recovery thrown in almost as a fringe benefit, take a look at *Disk Toolkit*.

DS Recover

The $49.95 *DS Recover* is data insurance from Design Software. It squeezes in between you and DOS and prevents your operating system from making your worst mistakes fatal. It can unerase files, unremove directories, and even unformat entire disks. The latest version (1.10) even wards off power failure worries.

To gain all of this increased security, you must regularly run two programs, Sentry and Save, as well as a number of other utility programs for maintaining your disk. These programs run either directly from the command line or from a menu-driven front-end.

Sentry changes the way DOS deletes files. Instead of marking the previously used clusters available, Sentry keeps them locked up and away from reuse by using a number of hidden files. That way, the data they contain can never be overwritten. Every deleted file is saved, even when a filename is reused and deleted multiple times.

A separate utility shows a directory of all erased files and allows you to recover

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them completely and successfully without any guesswork, or purge them from your disk forever. If multiple files with the same name have been deleted, every version is listed along with its time and date stamp so you can locate the one you want.

The latest version of *DS Recover* supplements this before-the-fact file recovery system with an after-the-fact file recovery aid that works conventionally by interactively seeking out recycled clusters. In effect, the package gives you the best of both worlds in file recovery.

Save duplicates the disk directory and FAT elsewhere so that subdirectories or entire disks can be recovered after an errant FORMAT command.

Perhaps the biggest disadvantage of using Sentry is that your hard disk functions like a WORM (write-once, read-mostly) storage device. The manifold megabytes of your hard disk can rapidly get used up, particularly if you use software that makes many temporary files in the course of its work.

DS Recover gives you several options for dealing with such situations. The easiest is turning Sentry off when you use programs that make temporary files. The *DS Recover* disk management utilities also allow you to purge unnecessary files whenever you want during your normal disk housekeeping.

When a file is purged, it changes from hidden status to an ordinary deleted DOS file, so you just might get another chance to bring it back. However, its clusters are marked as available, so the resurrectabilty of its data may be short-lived.

Another new feature recently conferred on *DS Recover* is Snapshot, a utility that captures to disk everything currently in your computer's memory every 3 minutes (or other time you designate). If the power fails or your system crashes, you only lose the work you've done since the program's

PC MAGAZINE FACT FILE

DS Recover
Design Software
1275 W. Roosevelt Rd., #104
West Chicago, IL 60185
(800) 231-3088
(312) 231-4540
List Price: $49.95

Requires: 256K RAM, one disk drive, DOS 2.0 or later.

In Short: A before-the-fact, insurance-style erasure protection utility that allows unremoving directories, and unformatting disks as well as conventional after-the-fact file recovery. Not copy protected.

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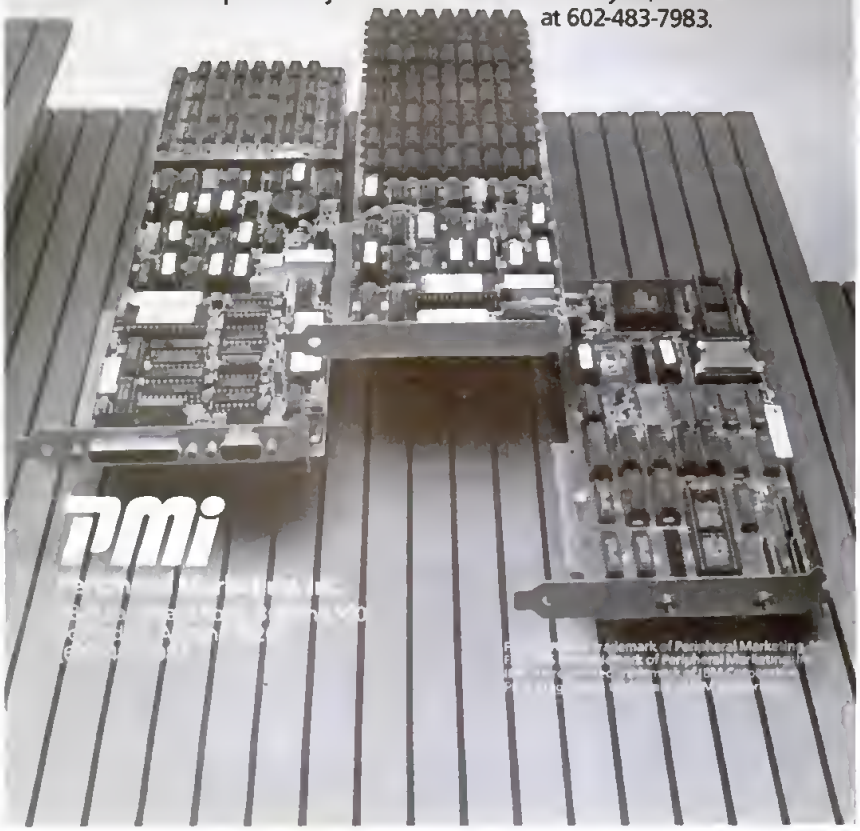

CIRCLE 532 ON READER SERVICE CARD

last save (an average of 1½ minute's worth). Pressing Alt-S can also take a snapshot of your system's memory whenever you want. Later, you can reload this memory snapshot and return to exactly the same place, with the same files loaded and same data in memory, as you were when the last snapshot was taken.

The various functions of *DS Recover* work cleanly and without fuss. Its menus are simple, and help is always available. The only disconcerting part of using the front-end program was its demand to search all disk subdirectories before you could do anything. When the disk directory structure is complex, that means a wait of several seconds even on a fast system. However, speed demons will probably prefer to use the program's command-driven option.

Mace Utilities

In contrast to Peter Norton's cool yuppie image, competitor Paul Mace gives the impression of being a down-home, salt-of-the-earth country sage who spouts common sense and aphorisms to all who come seeking his advice. His utilities carry the same rustic approach. They're hardworking and capable but likely to be cantankerous if you get on the wrong side of them.

The $99 *Mace Utilities* includes disk management, error-recovery, and speed optimization features.

Paul Mace's commonsense approach is first shown in the documentation's de-

PC MAGAZINE FACT FILE

Mace Utilities
Paul Mace Software
400 Williamson Way
Ashland, OR 97520
(503) 488-0224
List Price: $99
Requires: 256K RAM, two disk drives, DOS 2.0 or later
In Short: A down-home Norton clone that unerases, unremoves subdirectories, unformats disks, and optimizes the operation of floppy and hard disks. Not copy protected.

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scription of his undelete utility. In it, he explains that you should recover an erased file to a disk other than the one containing the erased file. That way if you make a mistake, you won't harm your original. He also makes a case against automatic undeleting programs, recommending the more time-consuming and tedious individual cluster selection process as more accurate and superior (hence he does not include a quick unerase function).

The *Mace Utilities* also has an unformatting system that uses the insurance approach—the system keeps a duplicate of the disk's main directory and FAT at a special location on the disk, where they can be retrieved in case of disaster. The utilities will also attempt to recover a reformatted disk even if the backup directory has not been made, although you must then reconstruct both file organization and names.

While the *Mace Utilities* allows you to recover removed subdirectories, the instructions for doing so assume that you've made the necessary backup directory for recovery from an accidental format recovery. On the other hand, a Reclaim utility will help pull data off damaged and even non-DOS disks with reasonable chances of success. A Restore Boot function allows you to copy new boot sectors to hard or floppy disks without resorting to direct sector writes.

Optimization utilities include the ability to sort subdirectories, eliminate erased entries from subdirectories, and reorganize disk clusters so that files are contiguous. In addition, the *Mace Utilities* includes a disk caching program that uses direct writing (information to be written to disk is not held in the buffer memory, which eliminates the possibility that data in the disk buffer will be lost in a system crash), a floppy speed enhancement called Vkette, and a video display enhancement called Vscreen that rewrites some BIOS routines to quicken the pace of displays.

The diagnostic functions include disk checking, with a graphic display of the results, and disk repair, which finds bad sectors and moves any data they might contain (possibly with errors unavoidably caused by the bad media) to safer storage.

A single, austere-looking front-end program links the *Mace Utilities*. Different versions load for systems with 256K and 512K or more bytes of RAM. The utilities come with two installation programs for copying the software to hard or floppy disks. Although the *Mace* programs themselves are not copy protected, they cannot be run from the distribution disk.

The utilities require that you locate both DOS COMMAND.COM and CHKDSK.COM in the same directory as the *Mace Utilities* for proper program operation.

The *Mace* manual is straight-shooting, informal, and informative. It includes a brief question-and-answer section, a guide to using the various utilities, and background information about how DOS disk storage works.

The *Mace Utilities* invites comparison with the *Norton* product. *Mace*'s features are comparable to *Norton*'s Version 4.0. But in other ways, *Mace* is primitive compared to the well-polished *Norton*. *Mace*'s manual is thin, and the utilities are less elegant, less complete, and include fewer options. However, the package is workable and offers a few unique options (an attempt at after-the-fact format recovery, disk speed-up) that recommend it to your DOS-enhancement arsenal.

The Nibbler

The Nibbler, from Tachyon Corp., is a $29.95 programmer's tool that also makes file recovery simple. It works essentially as a byte-level editor, allowing you to change any byte either in RAM or on disk.

The Nibbler operates both under DOS and beyond DOS by reading relative (DOS-style) and absolute sectors. Those capabilities extend its editing reach to include non-DOS disks with similar data structures, such as those made by some versions of CP/M and UCSD p-System. Of course, taking advantage of this ability is not for the novice; it requires an in-depth knowledge of how disk storage works.

Two versions of the program are supplied. One, Nib, is nearly 200K bytes long and loads in high memory. The other, Niblo, requires only about 80K and sneaks into low memory.

Because most application programs load in low memory, using the high-memory version of *The Nibbler* lets you probe through the remains of a program after you have exited from it. Most of the bytes of a program are left unchanged in RAM when you exit an application, and the high-memory (above-640K) version of *The Nibbler* does nothing to disturb them.

Similarly, the lower-memory version of *The Nibbler* does nothing to harm what's in high memory. Both versions have built-in buffers so that even when they execute, they don't disturb the memory areas around them.

The Nibbler is structured around a simple function-key oriented menuing system that uses Esc consistently to step backward and out of the program.

The Nibbler supports file functions such as copying, deleting, searching within files for specific text occurrences, viewing and editing file contents encrypting/decrypting using a simple password scheme, mapping the location of individual files on floppy disk (but not on hard disk), and unerasures.

The Nibbler's absolute sector reads are primarily useful for viewing and editing information located on a specified track, head, and sector. You can copy such information or transfer it from a non-DOS to a DOS disk.

The memory functions work similarly. You select locations to view or edit by address, and you can hold the results in memory or write them to disk.

The editor display is similar to that of DOS DEBUG—the left side of the screen is filled with a hexadecimal representation

PC MAGAZINE FACT FILE

nibbler

The Nibbler
Tachyon Corp.
2725 Congress St., #2H
San Diego, CA 92110
(619) 574-1666
List Price: $29.95
Requires: 128K RAM, one disk drive, DOS 2.0 or later.

In Short: A pair of quick-working but big memory-and disk-editing programs designed to cohabit with the remains of program code so you can poke around in it. Also includes explicit file recovery capabilities. Not copy protected.

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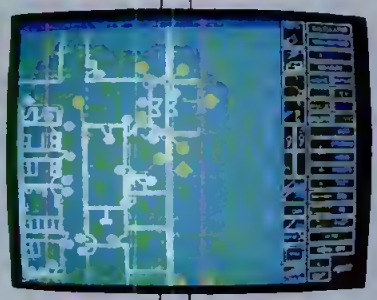

Get more business done. *On-screen menus (left screen) facilitate the production of contract documents. Drawings courtesy of Heard & Associates, Chicago, Illinois.*

Get more business. *Shaded pictures (right screen) like this help clients see your vision clearly from any perspective. An invaluable selling tool. Drawing courtesy of Stephen Douglass, Architect, Cambridge, Massachusetts.*

For more information on the Personal Architect write: Computervision Corporation, Personal Systems Business Unit, Building 16-2, 100 Crosby Drive, Bedford, MA 01730.

CIRCLE 159 ON READER SERVICE CARD

COMPUTERVISION
Personal Architect

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of byte values and the right shows ASCII—but each screen displays a full 512 bytes (equivalent to one complete disk sector).

Automatic file recovery is cut-and-dried. You pick an erased file from a directory listing by using a moving bar, supply a new initial character, and the program does the rest. If its special magic won't work, it informs you and allows you to use the byte-level editor to salvage what you can manually.

The Nibbler was the only utility package of this group to suffer any compatibility problems. It ran perfectly on a genuine IBM PC but locked up on an XT compatible after only a few keystrokes. If you are interested in the editing power, make certain that it will work on your system before you buy.

■ *The Norton Utilities Advanced Edition* has Version 4.0's features plus Speed Disk, which packs disk clusters and makes files contiguous, and an unformat feature.

The Norton Utilities, Version 4.0
The Norton Utilities Advanced Edition

The Norton Utilities is the program that started it all: the first successful enhancements for DOS. The star attraction of the Peter Norton Computing package was (and remains) its miracle-working unerase utility. Since its introduction over 5 years ago, *The Norton Utilities* has gone through several revisions—Version 4.0 is now current—and has attracted a host of imitators along the way.

With each new version, *The Norton Utilities* has improved, increasing in power, features, and ease of use. However, this latest release marks a change of direction, if not a bifurcation. Where there once was one package, now there are two: the ordinary *Norton Utilities* that sells for $100 and the *Advanced Edition* for $150. The *Advanced Edition* includes all of the features of Version 4.0 plus additional ones.

The two packages remain the same up

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CIRCLE 739 ON READER SERVICE CARD

to a point. Both contain the identical set of utility programs which, for the first time, are linked by a menu-driven front-end, called the Norton Integrator. All of the *Norton* features are selectable using a moving bar. Better yet, as you select each program, the right side of the screen lists its various options so you hardly need to glance at the documentation.

The program common to both versions of *The Norton Utilities* has an updated interface and a few mechanical aspects, but it remains functionally the same. Where function keys once reigned, control now rests in hot keys and moving bars. Despite this change, the default selections still lead you through manual file recovery.

The common program also includes a byte-level editor, but the two *Norton* packages include different abilities. In the ordinary *Norton Utilities*, editing is limited to disk data areas. The advanced version expands the prey to include the whole disk from boot to last sector, including directories, the FAT, and disk partition table.

All the other features of *The Norton Utilities* package are still available, from BEEP (which can now read files to play entire songs) to WipeDisk and WipeFile. Other subtle (and not-so-subtle) revisions and additions have also been made.

The carry-over programs include Directory Sort, which writes its changes to disk; Disk Test, which now will move files that are in danger and mark or unmark bad sectors; File Attributes, which will mark or unmark files as hidden, system, or read-only; File Find, which locates files by name anywhere on a disk; File Size, which lists the actual disk space used by the data in a file as well as the disk space it requires; List Directories; Line Print; Screen Attributes, which changes screen colors; System Information, which now includes a microprocessor speed test, a disk speed test, and a combined test; Time Mark; Text Search; and UnRemove Directory, which is pretty much self-explanatory.

Added to the previous endowment is ASK, which grabs typed text to help you make your batch files interactive, and Norton's Change Directory (NCD), that takes you to any subdirectory anywhere on a disk almost instantly; you merely type *part* of its name. For instance, NCD GARB will take you to the subdirectory named GARBAGE six levels down from anywhere on the disk. File Info allows you to append a 65-character description to each directory entry to help you remember what's what and where.

In addition to the functions of *The Norton Utilities*, Version 4.0, the *Advanced* package includes Speed Disk, which packs disk clusters and makes files contiguous, and an unformat feature. As with other unformat utilities, this one requires you to run a special program when you boot up and also during your daily routine.

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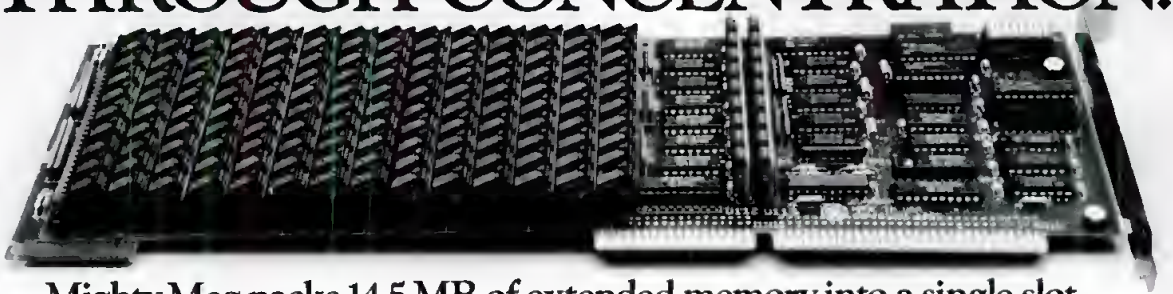

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■ FILE RECOVERY

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

▶ ***The Norton Utilities*, Version 4.0**
The Norton Utilities Advanced Edition
Peter Norton Computing
2210 Wilshire Blvd.
#186
Santa Monica, CA
90403
(213) 826-8032

List Price: *The Norton Utilities*, Version 4.0, $100; *The Norton Utilities Advanced Edition*, $150.

Requires: 192K RAM, two disk drives or hard disk, DOS 2.0 or later.

In Short: DOS-enhancement utilities, including two file programs (one prompted, one menu-driven), subdirectory recovery, byte-level editing, disk searches, file attribute altering, performance testing, security-level disk erasing, and many, many convenience features. *The Advanced Edition* also includes disk packing and unformat abilities. Not copy protected.

CIRCLE 616 ON READER SERVICE CARD

The unformat process restores the system to the place it was when last saved.

The documentation, which includes two manuals, is the best of any package evaluated here. One describes the utilities and their functions. The other tells you more than you might ever need to know about how DOS works.

All in all, *The Norton Utilities* is still the most feature-packed, most polished DOS enhancement available.

PC Tools

Central Point Software's $39.95 *PC Tools* bills itself as resident DOS utilities, and it excels at its claim. It acts as a menu-driven interface for many DOS functions. It also adds a variety of welcome functions such as the ability to unerase files and unremove subdirectories, move subdirectories, perform byte-level editing, copy, rename, verify and change the attributes of files, and give tree-structured directory displays and graphic disk maps. The just-released Version 3 also has unformatting, disk optimization, and improved backup/restore capabilities.

You can make all of those features (except for unformatting, optimization, and backup/restore) resident and ready for instant activation at a press of the Ctrl-Esc key combination.

In resident mode, *PC Tools* reserves a block of memory for carrying out its functions. The exact amount of memory usage is user-selectable. You specify a buffer size when loading the program: 64K bytes is the minimum, while 94K is recommended for 30-megabyte hard disk systems.

Although *PC Tools* requires 130K bytes of disk space, it consumes substantially less memory when resident. The program itself is not loaded into RAM but is called from disk (or from expanded memory in systems so equipped) when required. If you call the program through a path when expanded memory is unavailable, it puts an 87K-byte overlay file in the directory that is the default when you load the program.

The current version of *PC Tools*, 3.0, works like, but doesn't look like, Version 1.0, which was reviewed as a byte-level editor in "Easier than DOS DEBUG: Six Byte-Level Editors," *PC Magazine*, Volume 5 Number 17.

When you start the new version, either from the DOS prompt or in resident mode, you are presented with a screen that gives you a choice of disk- or file-oriented tools. The functions of the two types of tools overlap. But whenever you evoke file tools, *PC Tools* scans the whole default drive before returning control, which can be time-consuming if your task doesn't require such a read. Many, but not all, of the disk services force a directory read.

PC Tools has a menu at the bottom of the screen that gives you a selection of functions. You can choose a function by pressing a letter key; then *PC Tools* gives you a tree-mapped directory or text directory listing from which you select one or

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

PC Tools
Central Point Software
9700 SW Capitol Hwy.
#100
Portland, OR 97219
(503) 244-5782
List Price: $39.95
Requires: 192K RAM, (256K RAM for resident operation), one disk drive, DOS 2.0 or later.
In Short: An inexpensive memory-resident menu-driven DOS command and enhancement program with unerasing and subdirectory unremoving capabilities. Not copy protected.

CIRCLE 615 ON READER SERVICE CARD

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CIRCLE 241 ON READER SERVICE CARD

■ *PC Tools* can search disks for text, format floppy disks, and compare and verify files.

more files to perform some action on, such as erasing a group of backup files.

PC Tools keeps a running total of the size of the files that you choose so that you can, for instance, be certain that they will all fit on a floppy disk.

The program can also search disks for text, format floppy disks, display relevant system information (but not a speed test), and compare and verify files. Its byte-level editor functions both on the file level (so you can change the contents of any file) and on the disk level (so you can alter any byte on a disk, including the boot record, subdirectories, and FAT).

The file unerasing and subdirectory unremoving functions work similarly. After you select the item to recover, *PC Tools* prompts for a replacement first letter, then carries out the process automatically if it can. If automatic recovery is not possible, the program drops you into the byte-level editor and suggests replacement clusters. All changes made by the byte editor are first held in memory. You must then use a second step to save them to disk to avoid mistakes.

Two separate utilities provide the new unformatting feature of *PC Tools*, Version 3.0: Mirror, which duplicates the disk FAT and root directory; and Rebuild, which performs the actual recovery. Like all such unformatting systems, the one used by *PC Tools* puts your system back where it was the last time you ran the FAT-saving Mirror program.

Another new utility, Compress, makes the clusters used by individual hard disk files contiguous and also optimizes system performance by storing programs nearest the FAT and putting the newest files—those most likely to change—nearest the free disk space.

The PCBackup and PCRestor utilities work much like the DOS BACKUP and RESTORE programs, but they operate faster. In addition, PCBackup will format your disks on the fly.

If you're looking for memory-resident utilities, this is the package to get. It offers nearly every feature you could want in memory (except for disk optimization and unformatting), steals little memory, and works very quickly.

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Power Tools

MLI Microsystems' $55 *Power Tools* puts all the DOS enhancements you may ever need into a single, easy-to-use package that, once made memory resident, can be at your fingertips whenever your PC is running. In addition to all the normal DOS functionality, the program also allows file and subdirectory recovery, byte-level editing, disk diagnostics, and disk optimization. You can also search the disk or files for strings, locate or print files, change file attributes, and find out the technical characteristics of the host system, a disk, or a disk partition.

All those functions are unified by a single menu-driven interface that allows selection by either function keys or moving bar. Make your choice, and *Power Tools* asks you for a drive letter, then automatically scans through all of its subdirectories (necessitating a few seconds of waiting). A few more seconds, and it displays a tree-structured directory you pick the subdirectories or files you want to work on. Unfortunately, *Power Tools* does not remember the directory structure, and you are forced to go through the sometimes lengthy scan every time you choose a new function.

The various utilities, such as copying, moving, deleting, and verifying, operate on the file, directory, or disk level. You can group blocks of files for common action. *Power Tools* will also rename, locate, or compare files or change their attributes just as easily.

You have your choice of automatic or manual cluster selection for undeletions. In manual mode, the program selects likely clusters and shows them to you to accept or reject. The recovery is made directly on the disk from which the file was originally deleted. No direct method for subdirectory unremoval is supplied, but the byte-level editor will let you sidestep that minor shortcoming.

PC MAGAZINE FACT FILE

Power Tools
MLI Microsystems
P.O. Box 825
Framingham, MA 01701
(617) 879-2000
List Price: $55
Requires: 320K RAM, one disk drive, DOS 2.0 or later.
In Short: An inexpensive memory-resident menu-driven DOS command and enhancement program with unerasing and subdirectory unremoving capabilities. Not copy protected.

CIRCLE **614** ON READER SERVICE CARD

CIRCLE 324 ON READER SERVICE CARD

■ *Power Tools* can make files contiguous or pack clusters toward the beginning of the disk.

Although *Power Tools* won't help you recover from an inadvertent format, it does offer disk optimization. You can select the extent of disk optimization that you want to have carried out; *Power Tools* can make files contiguous or pack clusters toward the beginning of the disk.

When you make *Power Tools* DOS resident, either by making a menu selection or entering the program with the option -R on the command line, it modifies the prompt to include its initials so that you know the program is awaiting your command. (Of course, thereafter you can change the prompt to anything you want with the DOS PROMPT command.)

Press Alt and = (the "hot key" combination can be reassigned to avoid conflicts) and *Power Tools* will pop up even within other applications, allowing you to do your DOS dirty work in the middle of a spreadsheet. Making the program memory resident imposes a big penalty, however, consuming over 207K bytes.

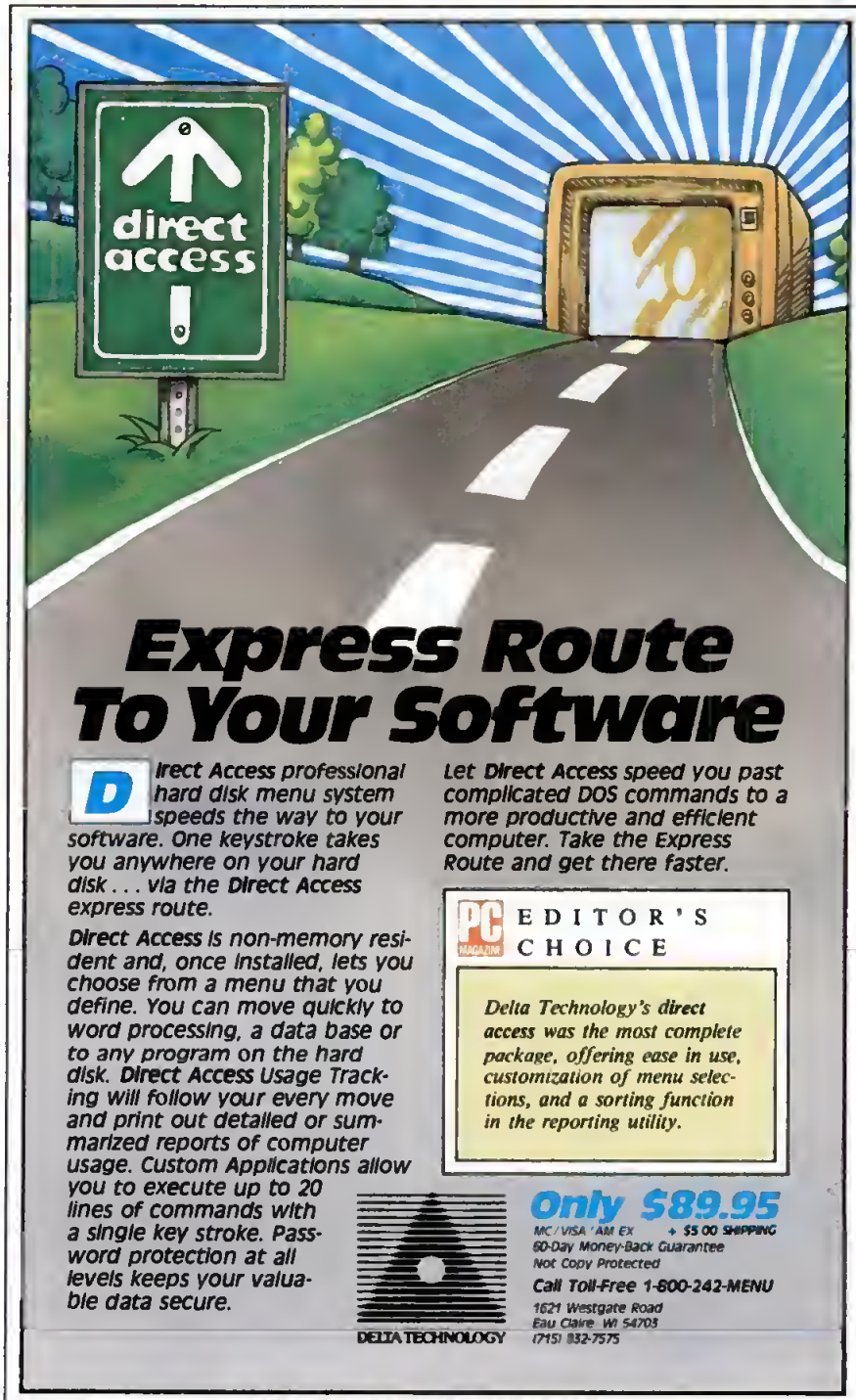
Power Tools is so easy to use that you probably won't need a manual, which is good because the documentation hardly rates as a manual. It lacks depth in describing the operation, purpose, and limitations of individual functions.

SafetyNet

Whenever an aerialist tries new deeds of derring-do, he spreads out a safety net to protect him from falls. For $59.95 *SafetyNet* software gives you the same insurance by saving your data should your system come crashing down. The program from Westlake Data Corp. allows you to unerase programs and subdirectories perfectly and even unformat entire hard disks.

Like the aerialist's life-saving net, *SafetyNet* is protection that requires forethought. Its file recovery option will not function unless you install *SafetyNet* first.

After you install *SafetyNet* (by typing the program name SNBoot), it swings into action by capturing DOS erase function calls and blocking them, preventing DOS from freeing previously written sectors. Instead, SNBoot keeps a backup copy of the disk FAT and directory in a special hidden area of the disk.



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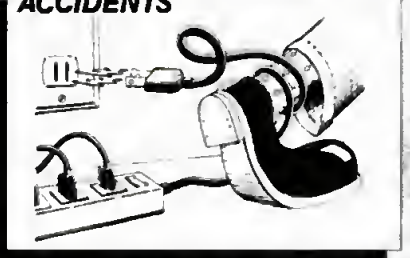

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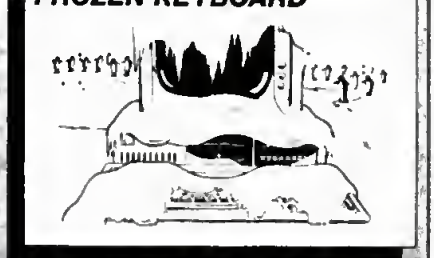

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■ FILE RECOVERY

PC MAGAZINE EDITOR'S CHOICE

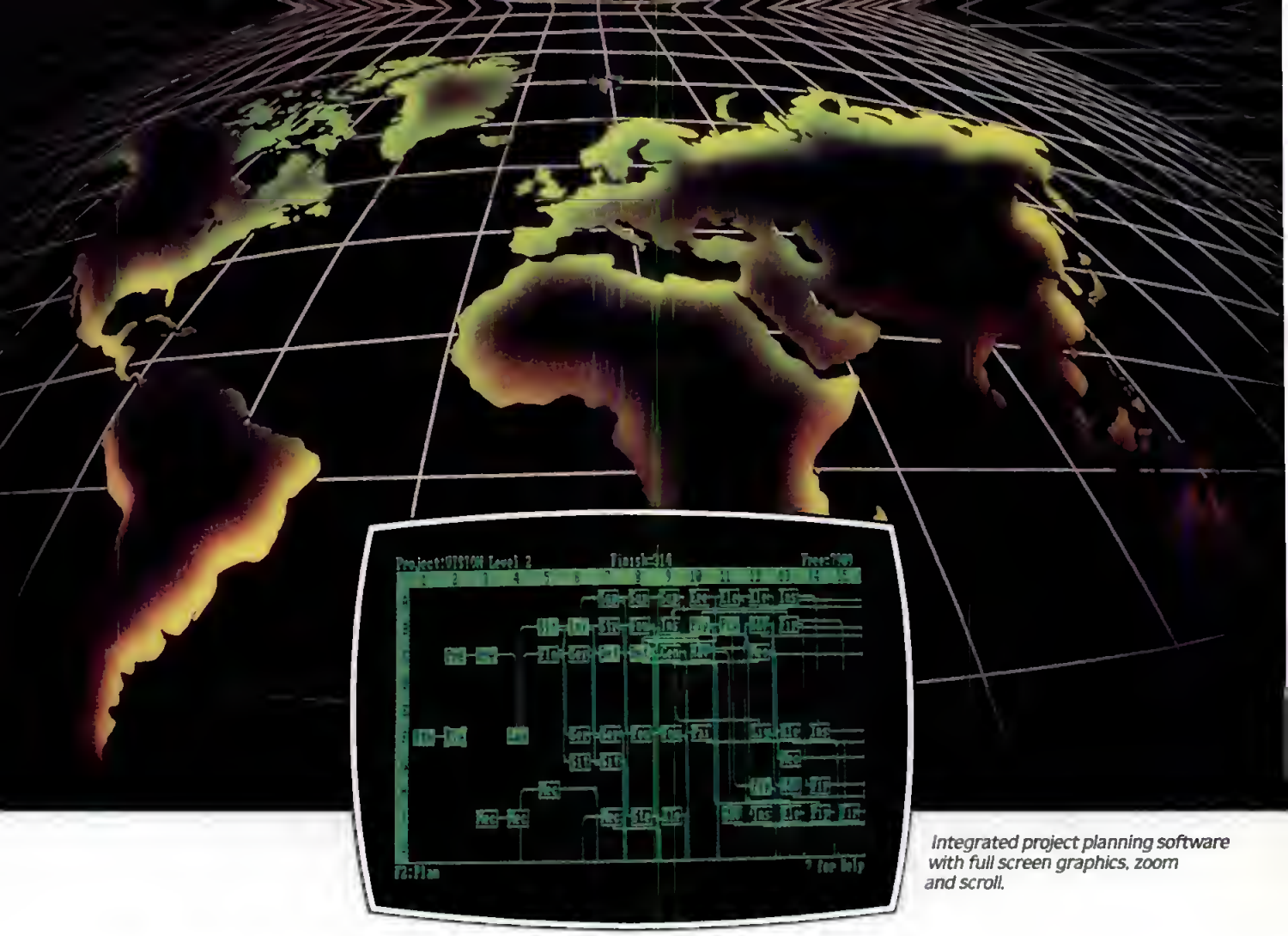
- **PC Tools**
- **The Norton Utilities, Version 4.0**
- **SafetyNet**

PC Tools, *from Central Point Software, offers the most features for the least money. Not only is it the least expensive program that will allow you to recover erased files, removed directories, and accidentally formatted disks, but it also allows you to run most DOS functions from within other applications. It consumes a modest amount of memory for its power, has many features, works well, and is quite polished.*

The venerable Norton Utilities *still earns a tip of our hat, too. The package provides the most functions—all of them so useful you'll wonder how you did without them—and it gives you the best documentation and the slickest presentation. Rather than buying the* Advanced Edition *at its $50 premium, however, we'd join* The Norton Utilities, *Version 4.0, with* PC Tools *(at $39.95) instead. You'll pay less, get all the added abilities of the* Advanced Edition, *and have its resident mode as a bonus.*

When it comes to before-the-fact erasure protection, the competition is much closer. We like Design Software's DS Recover *because it gives you a second chance—you can still unerase files that have been purged—and the program offers more features, including after-the-fact file recovery. However, with its ability to exclude temporary files from its protection, Westlake Data's* SafetyNet *edges out* DS Recover *as our pick.*

The erased-but-protected files are stored invisibly on disk. You cannot access or alter them in any way. However, the utility SN will unerase them automatically or purge them from the disk. After



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you purge a file, you can't recover it using after-the-fact file recovery programs.

SN presents an on-screen directory of all files that have been erased-but-protected and lists the time and date of creation so that you can readily distinguish multiple erased files with the same name. You select one or a group of them using a moving-bar menu system. Once you choose to unerase or purge (and confirm that action), SN works quickly: it can recover a dozen files in a few seconds.

As with other programs that protect erased data, *SafetyNet* can be fouled by applications that create extensive temporary files. It preserves each temporary file, rapidly consuming disk space.

Luckily, the latest version of *SafetyNet* includes an option that excludes specified files from the protection process, as determined by filename extension. Up to ten extensions can be excluded. For instance, excluding the extensions .TMP, .$$$, and .BAK will preclude the preservation of most temporary and backup files.

In addition, *SafetyNet* comes with three short utilities to turn its protection features on and off and to display its current status.

When you run SNBoot, it copies the disk directory and FAT to a special place on the disk so you can reconstruct the originals after a format command. Unformats are effective only for data saved before the last time you ran SNBoot and backup FATs and directories were written. Nevertheless, it will save most of your hard disk contents. (*SafetyNet*'s unformat does not work with floppies.)

SafetyNet may be the ironclad insurance policy you're looking for, especially because its filename extension exclusion feature sets it apart from other such programs and makes it a workable system.

Winn L. Rosch is a contributing editor of PC Magazine.

EDITOR'S CHOICE

PC MAGAZINE FACT FILE

SafetyNet
Westlake Data Corp.
P.O. Box 1711
Austin, TX 78767
(512) 328-1041
List Price: $59.95
Requires: 128K RAM, one disk drive, DOS 2.0 or later.
In Short: A before-the-fact, insurance-style erasure protection utility that also unremoves directories and unformats protected disks. Its ability to exclude files with specified name extensions makes it a workable system. Not copy protected.

CIRCLE 613 ON READER SERVICE CARD

"Mace Utilities 4.0 Best Data Recovery There is Gets Better"
PC Magazine
March 31, 1987
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CIRCLE 351 ON READER SERVICE CARD

■ PC LAB NOTES: TSR PROGRAM MANAGEMENT ■ JEFF PROSISE

POPPING OUT YOUR POP-UPS

Unloading resident programs usually means editing your AUTOEXEC.BAT and rebooting. INSTALL and REMOVE let you pop TSRs in and out on the fly.

The pop-up utilities we all take for granted today won't even run under the operating system introduced with the original PC in the fall of 1981. DOS 1.0, which in many ways mirrored the then-popular CP/M operating system, lacked what every memory-resident program must have. Only with DOS 1.1 did the PC's operating system provide a terminate-and-stay-resident feature—better known by the acronym TSR—that allows a portion of code to attach itself to the operating system.

Beginning with DOS 1.1, memory claimed by resident code could be set aside and protected from being overwritten by a subsequently loaded file. The ease with which a program could be made resident brought to the PC world a host of utilities—*SideKick* and *SuperKey*, to name but two—that let you do everything from maintaining an electronic desk to implementing complex keyboard macros.

Although the TSR tradition has been carried on with every release of DOS up through the current version (3.30), one often-needed additional feature is still conspicuous by its absence: the ability to remove resident code from memory. Interrupt 27h and DOS function 31h, the vehicles that allow a program to remain resident after completion, have no direct complement. Unless a TSR includes its own facilities to reverse the installation process, there's no way to clear memory of an unwanted TSR utility other than to reboot the entire system.

Theoretically, writing a TSR deinstallation utility is easy. A resident program does two things not typical of a normal one: it doesn't release the memory blocks it occupies upon termination, and it chains to itself one or more of the interrupt vectors stored in low memory. All it takes to erase a resident program from memory, therefore, is the two-step process of reclaiming the space and restoring the altered interrupt vectors.

Practically, it's easy enough to take care of the displaced interrupt vectors. What's more difficult is letting the operating system know that the memory occupied by the TSR program is free for reuse by another program. The removal utility must know exactly where the resident code lies in memory. Moreover, although DOS provides convenient functions for freeing up memory (see the accompanying sidebar "DOS Memory Management"), the deallocation requests must reverse the original allocation requests DOS made when it loaded the TSR very specifically. Thus, a prerequisite to writing a removal utility is understanding just what goes on behind the scenes when a file is loaded for execution.

By using the pair of utilities I'll present here, you'll be able to freely shuffle resident programs in and out of memory. INSTALL and REMOVE work together to eliminate the need to reboot in order to purge the system of resident code. You can selectively erase TSR programs in the reverse order in which they were loaded, eliminating one (or one group) at a time while leaving underlying ones active. And, so that you can check exactly what's happening, *PC Magazine*'s Robert L. Hummel has provided a logical addition to INSTALL/REMOVE in the form of PCMAP, a short utility that displays a memory map of the names, addresses, and sizes of all your currently loaded programs. (See the sidebar "A Memory-Mapping Utility.")

GETTING YOUR COPIES All three programs, INSTALL, REMOVE, and PCMAP, are available for downloading by modem (without charge) from the PC Magazine Interactive Reader Service. Downloading instructions are contained in

PRODUCTIVITY INDEX

PC LAB NOTES
INSTALL and REMOVE juggle your TSRs, and PCMAP charts your memory.
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DR injects file management abilities into directory listings.
SPREADSHEET CLINIC
Zapping out range names; opening up to extended ASCII characters.
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PC TUTOR
Boolean operations on binary bits and how the assembler adds them up.

■ PC LAB NOTES

```
;INSTALL.COM for the IBM Personal Computer - 1987 by Jeff Prosise
;
code            segment para public 'code'
                assume cs:code
                org 100h
begin:          jmp install                     ;skip data area
;
tsr_count       dw 0                            ;number of TSR's installed
segment table   dw 64 dup (?)                   ;wedge program segments
vector table    db 1024 dup (?)                 ;vector table storage area
first call      db 0                            ;INSTALL status flag
oldlAh          label dword                     ;storage for interrupt 1Ah vector
oldlAh vector   dw 2 dup (?)
errmsg          db 13,10,'No room for more',13,10,'$'
;
copyright       db 'Copyright 1987 Ziff-Davis Publishing Co.'
author          db 'Jeff Prosise'
;
;-----------------------------------------------------------------------
;NEW1AH routine intercepts calls to interrupt 1Ah.  If the function code is AH
;is 44h, then the Installation Data Table (IDT) segment is returned in ES.
;-----------------------------------------------------------------------
new1Ah          proc near
                sti                             ;enable interrupts
                cmp ah,44h                      ;is the function code 44h?
                je new1Ah1                      ;yes, then handle the call here
                jmp old1Ah                      ;jump to the real 1st 1Ah handler
new1Ah1:        push cs                         ;place current code segment in ES
                pop es
                dec bh                          ;decrement BH to verify call
                iret                            ;return to calling routine
new1Ah          endp
;
;-----------------------------------------------------------------------
;INSTALL routine saves pertinent data needed for deinstallation.
;-----------------------------------------------------------------------
install         proc near
                assume ds:code
;
;Begin by determining if this is the first call to INSTALL.
;
                mov ah,44h                      ;call int 1Ah, function 44h
                xor bh,bh                       ;zero BH
                int 1Ah
                cmp bh,0FFh                     ;BH=0FFh?
                je install11                    ;yes, then INSTALL is resident
                mov first call,1                ;no, then this is the first call
;
;See if there is room to record the installation of another TSR.
;
install11:      mov di,offset tsr count         ;point DI to installation count
                cmp word ptr es:[di],32         ;still room for more TSR's?
                jb install12                    ;yes, then continue
                mov ah,9                        ;no, then print error message
                lea dx,errmsg
                int 21h
                ret                             ;terminate
;
;Increment the count of TSR's installed and record correct PSP and environment
;block segment values.
;
install12:      mov es,es:[di]                  ;get TSR count in AX
                inc word ptr es:[di]            ;increment count
                mov cl,2                        ;multiply by 4
                shl ax,cl
                add ax,offset segment table     ;complete offset address
                mov di,ax                       ;transfer to DI
                mov es:[di],cs                  ;save current code segment value
                mov ax,cs:[2C6]                 ;get env block segment from PSP
                mov es:[di+2],ax                ;store it
;
;Copy the interrupt vector table from low memory into storage.
;
                push ds                         ;save DS
                xor ax,ax                       ;point DS:SI to 1st vector table
                mov ds,ax
                assume ds:nothing
                xor si,si
                push cs                         ;point ES:DI to storage area
                pop es
                lea di,vector table
                mov cx,512                      ;512 words to move
                cld                             ;clear DF
                cli                             ;suspend interrupts during move
                rep movsw                       ;copy vector table
                sti                             ;restore interrupts
                pop ds                          ;restore DS
                assume ds:code
;
;If INSTALL hasn't been called once before, reset the interrupt 1Ah vector.
;
                cmp first call,0                ;is this the first call?
                je install13                    ;no, then skip ahead
                mov ax,351Ah                    ;get old interrupt 1Ah vector
                int 21h
                mov old1Ah vector,bx            ;store it
                mov old1Ah vector[2],es
                mov ah,25h                      ;point vector to NEW16H routine
                lea dx,new1Ah
                int 21h
;
;Terminate-but-stay-resident.
;
install13:      mov dx,offset install           ;point DX to end
                int 27h                         ;terminate-but-stay-resident
install         endp
;
code            ends
                end begin
```

INSTALL.ASM: *The assembly language source code for INSTALL.COM.*

```
100 REM -- BASIC PROGRAM TO CREATE INSTALL.COM
110 OPEN "INSTALL.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO  27
150     LINESUM = 0
160     FOR J = 1 TO 8
170         READ BYTE
180         CHECKSUM = CHECKSUM + BYTE
190         LINESUM = LINESUM + BYTE
200         IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210         PUT #1
220     NEXT J
230     READ LINECHECK
240     IF LINECHECK <> LINESUM THEN PRINT "Error in Line";200 + 10 * I
241     IF I <> 1 GOTO 250
242         LSET A$ = CHR$(0)
243         FOR B = 1 TO 1152
244             PUT #1
245         NEXT X
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 19990 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,    224,      4,      0,      0,      0,      0,    461
300 DATA      0,      0,     13,     18,     70,    111,     32,    114,    358
310 DATA    111,    111,    109,     32,    102,    111,    134,     32,    722
320 DATA    109,    111,    114,    101,     13,     10,     36,     67,    561
330 DATA    111,    112,    121,    114,    105,    103,    104,    116,    886
340 DATA     32,     49,     57,     56,     55,     32,     90,    105,    476
350 DATA    102,    102,     45,     68,     97,    116,    105,    115,    752
360 DATA     32,     88,    117,     98,    108,    105,    115,    104,    759
370 DATA    108,    110,    103,     32,     67,    111,     46,     74,    648
380 DATA    101,    102,    102,     32,     80,    114,    111,    115,    757
390 DATA    105,    115,    101,    251,    128,    252,     68,    116,   1136
400 DATA      5,     46,    255,     46,    134,      5,     14,      7,    512
410 DATA    254,    207,    207,    100,     68,     50,    255,    205,   1426
420 DATA     26,    128,    255,    255,    116,      5,    190,      6,    909
430 DATA    133,      5,      1,    191,      3,      1,     38,    131,    503
440 DATA     61,     32,    114,      9,    180,      9,    141,     22,    568
450 DATA    138,      5,    205,     33,    195,     30,    139,      5,    758
460 DATA     38,    255,      5,    177,      2,    211,    224,      5,    917
470 DATA      5,      1,    139,    240,     30,    140,     13,     46,    638
480 DATA    361,     44,      8,     38,    137,     69,      2,     38,    481
490 DATA     51,    192,    142,    216,     51,    246,     14,      7,    919
500 DATA    141,     62,    133,      1,    185,      0,      2,    252,    776
510 DATA    250,    243,    165,    251,     31,    120,     62,    133,   1263
520 DATA      5,      0,    116,     21,    184,     26,     53,    205,    610
530 DATA     33,    137,     30,    134,      5,    140,      6,    136,    621
540 DATA      5,    100,     37,    141,     22,    211,      5,    205,    886
550 DATA     33,    186,    227,      5,    205,     39,      0,      8,    695
```

INSTALL.BAS: *A BASIC program that will automatically create INSTALL.COM.*

a sidebar of this issue's Programming/Utilities column. Three versions of each program are on PC-IRS: a ready-to-run .COM version, a source code .ASM listing, and a BASIC (.BAS) program that can be used to produce the .COM version simply by running it. If you do not have a modem, you can enter the appropriate listings from this article at your keyboard (INSTALL.ASM or INSTALL.BAS). The listings for REMOVE.ASM, REMOVE.BAS, PCMAP.ASM, and PCMAP.BAS are also reproduced in this article.

USING INSTALL/REMOVE Normally, a TSR utility is loaded simply by entering its name at the DOS prompt or as an entry in your AUTOEXEC.BAT file. In order to be able to control the loading/unloading of each TSR, you must run the INSTALL program before each TSR (or group of TSRs) is loaded. That way, pertinent information needed for removal can be intercepted and stored away. The syntax for INSTALL is

```
INSTALL [namelist]
```

where *namelist* is the name of the TSR utilities comprising the group about to be loaded. The *namelist* parameter is an optional descriptor containing up to 119 characters; it does not have to match the TSR filenames. The descriptor is used in the list of installed utilities presented when REMOVE is requested to perform a deinstallation.

The INSTALL utility is perhaps best understood if you think of it as a sort of bookmark applied to the operating system. When INSTALL is invoked, it records the

```
;REMOVE.COM for the IBM Personal Computer - 1987 by Jeff Prosise
;
ter_count       equ 0183h               ;pointer to installation count
segment_table   equ 0185h               ;pointer to wedge segment values
vector_table    equ 0185h               ;pointer to vector table
;
code            segment para public 'code'
                assume cs:code,ds:code
                org 100h
begin:          jmp remove              ;skip data area
;
copyright       db 'Copyright 1987 Biff-Davis Publishing Co.'
author          db 'Jeff Prosise'
;
errmsg1         db 13,10,'None installed',13,10,'$'
errmsg2         db 13,10,'Deinstallation failed',13,10,'$'
text1           db 13,10,'Number of installations: $'
text2           db 13,10,'Press ENTER to remove, ESC to abort',13,10,'$'
text3           db 13,10,'Deinstallation completed',13,10,'$'
data_segment    dw ?                    ;Installation Data Table segment
last_segment    dw ?                    ;Temporary segment storage
mcb_start       dw ?                    ;Segment address of first MCB
count           dw ?                    ;Number of TSR's installed
;
;-------------------------------------------------------------------------
;REMOVE procedure is the main body of the program.
;-------------------------------------------------------------------------
remove          proc near
;
;Make sure there is at least one TSR installed.
;
                mov ah,44h              ;Call Interrupt 1Ah, function 44h
                xor bx,bx               ;Zero BX
                int 1Ah
                cmp bx,0FFh             ;BX set to 0FFh on return?
                je remove1              ;Yes, then continue
                lea dx,errmsg1          ;No, then there's nothing to remove
exit1:          mov ah,9                ;Print error message and exit
                int 21h
                ret
;
;Print list of all installed and verify that the deinstallation should proceed.
;
remove1:        mov ah,9                ;Print 'Number of installations:'
                lea dx,text1
                int 21h
                mov ax,es:[ter_count]   ;Retrieve installation count
                mov count,ax            ;Save it
                call print_number       ;Print the installation count
                call print_crlf         ;Advance cursor 2 lines
                call print_crlf
                call print_ter_list     ;Print list of TSR's installed
                mov ah,9                ;Request verification to proceed
                lea dx,text2
                int 21h
remove2:        mov ah,0                ;Get user response
                int 16h
                cmp al,13               ;Was ENTER pressed?
                je remove4              ;Yes, then proceed
                cmp al,27               ;Was ESC pressed?
                jnz remove2             ;No, then try again
                ret                     ;Terminate
;
;Restore the interrupt vector table in low memory.
;
remove4:        push ds                 ;Save DS
                mov ds,last_segment     ;Point DX to wedge PSP segment
                assume ds:nothing
                mov si,vector_table     ;Point SI to stored vectors
                mov data_segment,es     ;Store IDT segment
                xor ax,ax               ;Point ES:DI to main vector table
                mov es,ax
                xor di,di
                mov cx,512              ;512 words to move
                cli                     ;Disable interrupts
                rep movsw               ;Restore interrupt vector table
                sti                     ;Enable interrupts
;
;Determine the segment address of the first memory control block.
;
find:           mov ax,es               ;Point ES to next segment
                inc ax                  ;Point AX to the one after it
                cmp byte ptr es:[0],4Dh ;Is MCB signature there?
                jne find                ;No, then loop
                cmp ax,es:[3]           ;Does next segment own this one?
                jne find                ;No, then loop
                mov mcb_start,es        ;Yes, then store it
;
;Scan all memory control blocks from the last wedge forward for PSP blocks.
;
                mov ds,data_segment     ;Set DS to IDT segment
                mov si,count            ;Calculate pointer into IDT
                dec si
                mov cl,2
                shl si,cl
                add si,segment_table
                mov bx,[si]             ;PSP segment of last wedge
remove3:        dec bx                  ;Address memory control block
                mov es,bx
                add bx,es:[3]           ;Calculate address of next MCB
                inc bx
                mov ax,bx               ;Transfer address to ES
                inc bx                  ;Advance BX to block segment
                cmp bx,es:[1]           ;Is this a PSP block?
                jne remove3             ;No, then advance to next block
                mov ax,cs               ;Get current PSP segment in AX
                cmp bx,ax               ;Have we reached our own PSP?
                je remove7              ;Yes, then exit loop
;
;Deallocate all blocks that belong to the code whose PSP segment is in BX.
;
                mov ax,mcb_start        ;Retrieve address of first MCB
remove6:        mov es,ax               ;Point ES to MCB
remove66:       add ax,es:[3]           ;Calculate address of next MCB
                inc ax
                mov ax,ax               ;Transfer address to ES
                cmp byte ptr es:[0],5Ah ;Last block in the chain?
                je remove5              ;Yes, then exit loop
                cmp bx,es:[1]           ;Does the ownership word match?
                jne remove66            ;No, then try next block
                mov dx,es               ;Save segment value in DX
                inc ax                  ;Advance AX to PSP block
                mov es,ax               ;Transfer to ES
                mov ah,49h              ;Deallocate block
                int 21h
                jc mem_error            ;Branch on error
                mov ax,dx               ;Restore AX
                jmp remove6             ;Loop back for more
;
;Deallocate the memory used by the resident wedge left behind by INSTALL.
;
remove7:        mov es,[si+2]           ;Point ES to wedge env segment
                mov ah,49h              ;Deallocate block
                int 21h
                jc mem_error            ;Branch on error
                mov es,[si]             ;Point ES to wedge PSP segment
                mov ah,49h              ;Deallocate block
                int 21h
                jnc remove8             ;Branch if no error
;
;Memory deallocation failed.  Print message and terminate.
;
mem_error:      pop ds                  ;Set DS to code segment
                assume ds:code
                lea dx,errmsg2          ;Point DS:DX to error text
                jmp exit1               ;Exit
;
;Memory was successfully deallocated.  Decrement TSR count and exit.
;
remove8:        pop ds                  ;Restore DS
                mov es,data_segment     ;Recover IDT segment
                dec word ptr es:[ter_count] ;Decrement installation count
                lea dx,text3            ;Print message and exit
                jmp exit1
remove          endp
;
;-------------------------------------------------------------------------
;PRINT_NUMBER writes the number held in AL to the display.
;-------------------------------------------------------------------------
print_number    proc near
                aam                     ;Convert value in AL to BCD in AX
                add ax,3030h            ;Binary to ASCII
                cmp ah,30h              ;First digit zero?
                je print1               ;Yes, then don't print it
                push ax                 ;Save AX
                mov dl,ah               ;Transfer digit to DL
                mov ah,2                ;INT 21h function number
                int 21h                 ;Print the first digit
                pop ax                  ;Recover AX
print1:         mov ah,2                ;INT 21h function number
                mov dl,al               ;Transfer digit to DL
                int 21h                 ;Print the digit
                ret
print_number    endp
;
;-------------------------------------------------------------------------
;PRINT_TSR_LIST writes a list of all TSR's present in memory.
```

(continues)

REMOVE.ASM: *The assembly language source code for REMOVE.COM.*

current state of the system; each time REMOVE is run, it restores the system to the state it was in just before the last INSTALL. Any TSRs that were loaded since the last INSTALL are disabled. Up to 32 system states can be docketed. If you want the ability to delete TSRs individually, you must be sure to run INSTALL before loading each TSR. At the other extreme, you could run INSTALL only once, right after the system power-up, then load all the resident utilities your system can hold. In this latter case, a single call to REMOVE would purge them all.

To illustrate just how INSTALL is used, the following sequence (which might be included in an AUTOEXEC .BAT file) installs four resident programs. TIMEKEY and FREEZE, a pair of utilities that appeared in *PC Magazine*'s Programming/Utilities column, are each preceded by INSTALL, so that they can be deleted one at a time. *SuperKey* and *SideKick*, the venerable Borland utilities, are here loaded consecutively so that they will be erased as a group:

```
INSTALL TIMEKEY
TIMEKEY
INSTALL FREEZE
FREEZE
INSTALL SUPERKEY SIDEKICK
KEY
SK
```

Eliminating the last TSR or group of TSRs is as simple as running REMOVE. REMOVE displays a list of utilities currently installed (by echoing the descriptive names you typed in on INSTALL's com-

■ PC LAB NOTES

```
;Entry:  ES - Installation Data Table segment
;-----------------------------------------------------------------------
prtet_ter_llst proc near
                cld                             ;clear DF
                mov cx,count                    ;get count of TSR's installed
                mov dl,segment table            ;point DI to wedge segment values
                push ds                         ;save DS
                assume ds:nothing
printoum1:      mov ds,es:[dl]                  ;get wedge segment address in DS
                mov last_segment,ds             ;store it for later
                mov si,82h                      ;point SI to command line
                cmp byte ptr [si-2],1           ;more than 1 character entered?
                jbe printnum3                   ;no, than no name defined
                push cx                         ;save TSR count
                mov cl,[si-2]                   ;get length of TSR name in CX
                xor ch,ch
                dec cx
printnum2:      lodsb                           ;get a character
                mov ah,2                        ;print it
                mov dl,al
                int 21h
                loop printnum2                  ;loop until done
                pop cx                          ;retrieve TSR count
printoum3:      call print crlf                 ;advance cursor to next line
                add dl,4                        ;point ES:DI to next segment value
                loop printnum1                  ;loop until all names printed
                pop ds                          ;restore DS
                assume ds:code
                ret
print ter list endp
;
;-----------------------------------------------------------------------
;PRINT CRLF advances the cursor to the beginning of the next line.
;-----------------------------------------------------------------------
print_crlf      proc near
                mov ah,2                        ;print carriage return
                mov dl,0Dh
                int 21h
                mov ah,2                        ;print linefeed
                mov dl,0Ah
                int 21h
                ret
print crlf      endp
;
code            ends
                end begin
```

(REMOVE.ASM ends)

```
100 REM -- BASIC PROGRAM TO CREATE REMOVE.COM
110 OPEN "REMOVE.COM" AS 61 LEN = 1
120 FIELD 41,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO 69
150    LINESUM = 0
160    FOR J = 1 TO 8
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210       PUT #1
220    NEXT J
230    READ LINECHECK
240    IF LINECHECK <> LINESUM THEN PRINT "Error in Line";200 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 51889 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA   233,   202,     0,    67,   111,   112,   121,   114,   660
300 DATA   105,   103,   104,   116,    32,    46,    57,    56,   622
310 DATA    55,    32,    90,   105,   102,   102,    45,    68,   599
320 DATA    97,   110,   105,   115,    32,    80,   117,    88,   762
330 DATA   100,   105,   115,   104,   105,   110,   103,    32,   782
340 DATA    87,   111,    46,    74,   101,   102,   102,    32,   635
350 DATA    80,   114,   111,   315,   105,   115,   101,    13,   754
360 DATA    10,    70,   111,   110,   101,    32,   105,   110,   657
370 DATA   315,   116,    97,   100,   100,   101,   100,    11,   758
380 DATA    10,    36,    13,    10,    68,   101,   105,   110,   453
390 DATA   116,   116,    67,   100,   100,    67,   116,   105,   662
400 DATA   111,   110,    32,   102,    67,   105,   100,   101,   766
410 DATA   100,    13,    10,    36,    13,    10,    70,   117,   377
420 DATA   100,    68,   101,   114,    32,   111,   102,    32,   696
430 DATA   105,   110,   115,   116,    87,   100,   100,    87,   856
440 DATA   116,   105,   111,   110,   115,    58,    32,    36,   683
450 DATA    13,    10,    80,   114,   101,   115,   115,    32,   580
460 DATA    69,    70,    84,    69,    82,    32,   116,   111,   641
470 DATA    32,   114,   101,   300,   111,   110,   101,    44,   718
480 DATA    32,    69,    83,    67,    32,   110,   111,    32,   542
490 DATA    87,    98,   111,   114,   110,    13,    10,    36,   565
500 DATA    13,    10,    68,   301,   105,   110,   115,   116,   638
510 DATA    87,   100,   100,    87,   116,   105,   111,   110,   852
520 DATA    32,    66,   111,   106,   112,   100,   101,   116,   788
530 DATA   101,   100,    33,    10,    36,     0,     0,     0,   260
540 DATA     0,     0,     0,     0,     0,   180,    68,    50,   298
550 DATA   255,   205,    26,   128,   255,   255,   116,     6,  1246
560 DATA   141,    22,    55,     1,   160,     9,   205,    13,   646
570 DATA   165,   100,     9,   141,    22,   100,     1,   205,   853
580 DATA    33,    18,   161,     3,     1,   161,   203,     1,   681
590 DATA   232,   211,     0,   232,    30,     1,   232,    27,   865
600 DATA     1,   232,   227,     0,   160,     9,   141,    22,   812
610 DATA   128,     1,   205,    33,   100,     0,   205,    22,   774
620 DATA    68,    13,   116,     6,    60,    27,   117,   244,   642
630 DATA   165,    18,   142,    18,   166,     1,   160,   133,   828
640 DATA     1,    46,   140,     6,   167,     1,    51,   192,   634
650 DATA   142,   182,    51,   255,   185,     0,     2,   250,  1077
660 DATA   241,   165,   251,   142,   192,    64,    38,   128,  1221
670 DATA    62,     0,     0,    77,   117,   245,    38,    50,   568
680 DATA     6,     1,     0,   117,   210,    46,   140,     6,   554
690 DATA   201,     1,    46,   142,    38,   167,     1,    46,   664
700 DATA   116,    54,   203,     1,    70,   177,     2,   211,   865
710 DATA   218,   126,   160,     5,     1,   130,    20,    75,   885
720 DATA   142,   365,    30,     3,    10,     3,     0,    87,   478
730 DATA   142,   165,    67,    38,    59,    30,     1,     0,   632
740 DATA   117,   237,   140,   200,    50,   216,   118,    44,  1120
750 DATA    46,   161,   201,     1,   142,   162,    38,     3,   784
760 DATA     6,     3,     0,    64,   142,   392,    38,   120,   573
770 DATA    62,     0,     0,    60,   116,   200,    38,    50,   574
780 DATA    10,     1,     0,   117,   213,   130,   200,    64,   762
790 DATA   142,   162,   188,    73,   285,    33,   114,    21,   860
800 DATA   116,   164,   235,   216,   142,    60,     2,   180,  1176
810 DATA    73,   285,    33,   114,     0,   142,     4,   100,   759
820 DATA    73,   285,    33,   115,     0,    31,   341,    22,   628
830 DATA    74,     1,   233,    30,   265,    31,   142,     6,   701
840 DATA   167,     1,    30,   255,    14,     3,     1,   141,   650
850 DATA    22,   160,     1,   233,    22,   265,   212,    10,   823
860 DATA     5,    40,    40,   128,   252,    40,   116,     0,   653
870 DATA    80,   130,   212,   180,     2,   205,    33,    80,   830
880 DATA   160,     2,   138,   200,   205,    33,   185,   252,  1213
890 DATA   139,    14,   203,     1,   101,     5,     1,    30,   504
900 DATA    38,   142,    26,    48,   140,    30,   100,     1,   625
910 DATA   190,   130,     0,   128,   124,   254,     1,   110,   845
920 DATA    17,    81,   136,    76,   254,    58,   237,    73,   926
930 DATA   172,   100,     2,   130,   200,   205,    33,   226,  1164
940 DATA   247,    86,   232,     7,     0,   131,   186,     4,   600
950 DATA   226,   214,    31,   186,   100,     2,   170,    11,  1038
960 DATA   205,    33,   100,     2,   170,    10,   205,    33,   846
970 DATA   165,     0,     0,     0,     0,     0,     0,     0,   165
```

REMOVE.BAS: *A BASIC program that will automatically create REMOVE.COM.*

mand line) and prompts you to verify by pressing the Enter key. If the four utilities had been installed as shown above, running REMOVE would produce the following display:

```
Number of installations: 3

TIMEKEY
FREEZE
SUPERKEY SIDEKICK

Press ENTER to remove, ESC to abort
```

If you press the Enter key, the last group, *SuperKey* and *SideKick*, will be released from memory. Pressing the Esc key simply terminates the deinstallation harmlessly. Successive utilities may be deleted through successive calls to REMOVE. Running REMOVE a second time in the example above would show only two installations recorded, with FREEZE the topmost TSR queued to be deleted next.

It's perfectly legitimate to load more TSRs than was indicated in the *namelist* parameter. REMOVE will still delete everything entered since the last INSTALL. REMOVE's list of installed utilities, however, reflects only those designated on INSTALL's command line. If you choose, you can even leave the command line empty. It's usually convenient, however, to have an accurate list of TSRs presented every time you run REMOVE.

INSTALL is itself a short memory-resident utility. Every time it's called, it consumes about 1600 bytes of memory, but, more importantly, it inserts a resident "wedge" in memory that contains a complete copy of the PC's interrupt vector table. A utility not preceded somewhere in memory by one of these wedges cannot be removed. REMOVE recovers both the memory used by the programs it unloads and the memory dedicated to their identifying wedge.

INSTALL answers the command to load additional groups beyond the limit of 32 with the message, "No room for more." Likewise, when REMOVE is executed with no TSRs installed, it responds with the warning, "None installed." Resident programs can be freely INSTALLed and REMOVEd as many times as you wish. In addition, there's no limit to the number of TSRs you can place in a group.

Note that programs (or groups of programs) can be deleted only in the reverse order in which they were installed. The removal of an intermediate one would create all sorts of problems, one of which would be the tricky proposition of moving all res-

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■ PC LAB NOTES

```
;-----------------------------------------------------------------
;  PCMAP - Search through memory and print out the program names (for
;  DOS 3.x) and the number of bytes assigned to each in memory.
;-----------------------------------------------------------------
CSEG    SEGMENT PARA PUBLIC 'CODE'          ;Start CODE segment
        ASSUME  CS:CSEG,DS:CSEG,ES:CSEG,SS:CSEG ;Set by DOS Loader
        ORG     100H                        ;COM file format

CR      EQU     0DH                         ;Common equates
LF      EQU     0AH
TAB     EQU     09H

ENTRY:  JMP     PCMAP                       ;Jump over data

;-----------------------------------------------------------------
COPYRIGHT DB  "PCMAP 1.0 (c) 1987, Kliff-Davis Publishing Corp."
AUTHOR    DB  CR,LF,LF,'$',13e,"Robert L. Hummel"

HEADING_MSG     DB      "Segment Pa:ographe     Program"
CR_LF_MSG       DB      CR,LF,'$'
COM_MSG         DB      "COMMAND.COM"
UNK_MSG         DB      "(Unknown)"
FREE_MSG        DB      "(Free)"
SPACE_MSG       DB      7 DUP(' '),'$'
N_BLK           DB      0                   ;Count table entries
VER3            DB      0                   ;=1 if Version 3.x

;-----------------------------------------------------------------
PCMAP           PROC    NEAR

                MOV     DX,OFFSET COPYRIGHT
                MOV     AH,9                ;Display string
                INT     21H                 ; Thru DOS

                MOV     ax,30H              ;Check DOS version
                INT     21H                 ; Thru DOS
                CMP     AL,3                ;If not 3.x
                JB      MOV_3               ; don't turn on flag
                INC     VER3                ; else, indicate
NOT_3:
;-----------------------------------------------------------------
;  Find the first MCB by scanning through memory.
;  On exit, ES points to the MCB.
;       AX=Block Address, BX=ES, CX=Owner, DX=Top of memory.
;-----------------------------------------------------------------
                XOR     BX,BX               ;Zero BX
SEARCH_MEM:
                MOV     ES,BX               ;Point segment to 0
        ASSUME ES:NOTHING                   ;To i the assembler

                CMP     BYTE PTR ES:[0],'M' ;Is this a MCB?
                JE      CHECK_MCB           ; Might be
CRAWL:
                INC     BX                  ;Point to next segment
                JMP     SEARCH_MEM          ; continue search
CHECK_MCB:
                MOV     AX,BX               ;The MCB segment should
                INC     AX                  ; belong to the next segment
                MOV     CX,WORD PTR ES:[1]  ;If owner of this block
                CMP     AX,CX               ; is the same as the block
                JNE     CRAWL               ; is first legitimate block
FOUND_FIRST:
                MOV     DX,WORD PTR DS:[2]  ;Top of memory

;-----------------------------------------------------------------
;  If the owner=0, then the block is unallocated (free).
;       AX=Mem Address, BX=ES, CX=Owner, DX=Top of memory,
;  Look up OWNER in table.
;-----------------------------------------------------------------
WORK_1:
                CLD                         ;String moves forward
                MOV     DI,OFFSET TABLE     ;Where to look

                MOV     CX,WORD PTR ES:[1]  ;Get owner of this Block
                MOV     AL,0 BLK            ; number to look at
SEARCH_TABLE:
                OR      AL,AL               ;If no entries are left
                JZ      CREATE_ENTRY        ; create a new one
                DEC     AL

                OR      CX,CX               ;If unallocated
                JZ      SKIP_ENTRY          ; just skip to end

                MOV     SI,WORD PTR [DI]    ;Get PID of owner
                CMP     CX,SI               ;If owner matches
                JE      ADD_LEN             ; add more length
SKIP_ENTRY:
                ADD     DI,17               ;Point to next entry
                JMP     SEARCH_TABLE

;-----------------------------------------------------------------
;  Assume dr points to last empty spot.
;-----------------------------------------------------------------
CREATE_ENTRY:
                INC     N_BLK               ;Adding new entry
                MOV     AX,CX
                OR      CX,CX               ;If block is free
                JNZ     NOT_FREE
                MOV     AX,BX               ;Put mem address as owner
                INC     AX
NOT_FREE:
                MOV     WORD PTR [DI],AX    ;Put owner in table
                MOV     WORD PTR [DI][2],0  ;Zero initial length
ADD_LEN:
                MOV     SI,WORD PTR ES:[3]  ;Block Length

                INC     BX                  ;Inc len to point bx...
                MOV     AX,BX               ; (point AX to mem)
                ADD     BX,SI               ;...to next MCB
                ADD     WORD PTR [DI][2],SI ;Increase para count

                MOV     SI,OFFSET FREE_MSG  ;Memory is free
                OR      CX,CX               ; if owner = 0
                JNZ     HAVE_OWNER
                MOV     CX,6                ;Length of string
                JMP     COPY_NAME           ;Copy to TABLE
HAVE_OWNER:
;-----------------------------------------------------------------
;  Is this block a priory (program) Block?
;-----------------------------------------------------------------
                CMP     AX,CX               ;If mem = owner
                JNE     FIND_NEXT           ;N
```

```
;-----------------------------------------------------------------
;  This is a program block.  Word at offset 2Ch into the Block contains
;  environment segment address.  (offset from current ES by 1 paragraph)
;-----------------------------------------------------------------
                MOV     SI,WORD PTR ES:[2Ch+10h] ;Get env segment
                CMP     N_BLK,1             ;If not first block
                JNE     CHECK_ENV           ; look for environment

                MOV     SI,OFFSET COM_MSG   ;Put name in table
                MOV     CX,11               ;String length
COPY_NAME:
                ADD     DI,4                ;String destination
                PUSH    CS                  ;Point ES to
                POP     ES                  ; this segment
                REP     MOVSB               ;Move the bytes
                MOV     AL,'$'              ;DOS string terminator
                STOSB                       ;Store it
                PUSH    CS                  ;Restore DS
                POP     DS
                JMP     SHORT FIND_NEXT

;-----------------------------------------------------------------
;  Is the environment still allocated to the owner?
;-----------------------------------------------------------------
CHECK_ENV:
                CMP     VER3,0              ;If not 3.x
                JE      NO_ENV              ; skip this section
                DEC     SI                  ;Point to env MCB
                PUSH    SI                  ;Put seg in DS
                POP     DS
                CMP     CX,WORD PTR DS:[1]  ;Compare owners
                JNZ     NO_ENV              ;Not our property

;-----------------------------------------------------------------
;  Point DS:SI to the environment and scan for the double zero entry.
;-----------------------------------------------------------------
                INC     SI                  ;Point SI to environment
                PUSH    SI                  ; and put in DS
                POP     DS
                XOR     SI,SI               ;DS:SI = ENV:0
                INC     SI

SCAN_ENV:
                DEC     SI                  ;Backup one byte
                LODSW                       ;Look at word
                OR      AX,AX               ;If not double 0 byte
                JNZ     SCAN_ENV            ;Continue to look

;-----------------------------------------------------------------
;  Find the end of the program pathname.
;-----------------------------------------------------------------
                LODSW                       ;Skip a word (# strings)
                MOV     BP,SI               ;Point to 1st char
                DEC     BP
SCAN_PATH:
                LODSB                       ;Read char at SI
                OR      AL,AL               ;If 0, end of string
                JNZ     SCAN_PATH           ; else continue reading

;-----------------------------------------------------------------
;  SI points past the terminating 0.  Scan backwards for the ..
;-----------------------------------------------------------------
                DEC     SI                  ;Point SI to 0
                MOV     CX,SI               ;Point CX past last char
SCAN_NAME:
                DEC     SI                  ;Point to char
                CMP     SI,BP               ;Is it 1st char?
                JE      STRING_START
                CMP     BYTE PTR [SI],'.'   ;It is backslash?
                JNE     SCAN_NAME           ; no, continue
STRING_START:
                INC     SI                  ;Point to start of string
                SUB     CX,SI               ;Length of string
                JMP     COPY_NAME           ;Transfer
NO_ENV:
                PUSH    CS                  ;Restore DS
                POP     DS
                MOV     CS,9                ;Number of chars
                MOV     SI,OFFSET UNK_MSG   ;Unknown
                JMP     COPY_NAME           ;Transfer

;-----------------------------------------------------------------
;  Point ES to next MCB and continue search.  Stop at top of memory.
;-----------------------------------------------------------------
FIND_NEXT:
                MOV     ES,BX               ;Set ES to next paragraph
                CMP     BX,DX               ;At top of memory?
                JE      NO_MORE             ; then done
                JMP     WORK_1              ;else continue
NO_MORE:
;-----------------------------------------------------------------
;  Display the resulting table on the screen.
;-----------------------------------------------------------------
                MOV     DX,OFFSET HEADING_MSG ;Display the heading
                MOV     AH,9                ;Display string
                INT     21H                 ; Thru DOS
                MOV     SI,OFFSET TABLE     ;Table location
                MOV     CL,N_BLK            ;Number of entries
                XOR     CH,CH               ; as a word
PRINT_TABLE:
                CALL    PRINT_HORD          ;Print owner
                CALL    PRINT_WORD          ;and size

                MOV     DX,SI               ;Save of owner
                MOV     AH,9                ;Display string
                INT     21H                 ; Thru DOS
                ADD     SI,11               ;Point to next entry
                MOV     DX,OFFSET CR_LF_MSG ;Newline
                MOV     AX,9                ;Display string
                INT     21H                 ; Thru DOS
                LOOP    PRINT_TABLE

                MOV     AX,4CH              ;Terminate program
                INT     21H                 ;Thru DOS

PCMAP           ENDP

;-----------------------------------------------------------------
PRINT_WORD      PROC    NEAR
```

(continues)

PCMAP.ASM: *The assembly language source code for PCMAP.COM.*

■ PC LAB NOTES

```
                LODSW                           ;Get owner
                CALL    HEX4                    ;Write 4 digits
                MOV     DX,OFFSET SPACE_MSG     ;space over
                MOV     AH,9                    ;Display string
                INT     21H                     ; Thru DOS
                RET

PRINT_WORD      ENDP

;-----------------------------------------------------------------------------
;  HEX4 - Write AX as 4 hex digits to console
;  HEX2 - Write AL as 2 hex digits to console
;-----------------------------------------------------------------------------
HEX4            PROC    NEAR

                PUSH    AX                      ;Save register
                MOV     AL,AH                   ;Show high digits first
                CALL    HEX2                    ;Display AL
                POP     AX                      ;Restore low digits in AL

HEX2            PROC    NEAR                    ;Display AL

                PUSH    AX                      ;Save register
                PUSH    CX                      ;Save CX during shift
                MOV     CL,4
                SHR     AL,CL                   ;Get high 4 bits
                POP     CX                      ;Restore CX

                CALL    H2C                     ;Display upper AL digit
                POP     AX                      ;Restore lower
                AND     AL,0FH                  ;Mask and display

H2C:
                ADD     AL,90H                  ;Convert AL to ASCII
                DAA
                ADC     AL,40H
                DAA

                PUSH    DX                      ;Save register during call
                MOV     DL,AL                   ;Character in DL
                MOV     AH,2                    ;Display Output Fn
                INT     21H                     ; Thru DOS
                POP     DX                      ;Restore register

                RET

HEX2            ENDP
HEX4            ENDP

;-----------------------------------------------------------------------------
;  Format is TABLE  DB  20 DUP (0,0, 0,0,"              ")
;-----------------------------------------------------------------------------
TABLE           LABEL   BYTE

;-----------------------------------------------------------------------------
CSEG    ENDS
        END     ENTPT
```

(PCMAP.ASM ends)

```
100 REM -- BASIC PROGRAM TO CREATE PCMAP.COM
110 OPEN "PCMAP.COM" AS #1 LEN = 1
120 FIELD #1,1 AS A$
130 CHECKSUM = 0
140 FOR I = 1 TO 59
150     LINESUM = 0
160     FOR J = 1 TO 8
170         READ BYTE
180         CHECKSUM = CHECKSUM + BYTE
190         LINESUM = LINESUM + BYTE
200         IP (BYTE + 256) THEN LSET A$ = CHR$(BYTE)
210         PUT #1
220     NEXT J
230     READ LINECHECK
240     IF LINECHECK <> LINESUM THEN PRINT "Error in Line";200 + 10 * I
250 NEXT I
260 CLOSE
270 IP CHECKSUM = 44868 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,   134,     0,    80,    67,    77,    45,    80,   738
300 DATA     32,    49,    46,    48,    32,    48,    99,    41,   387
310 DATA     32,    49,    57,    54,    55,    44,    32,    68,   415
320 DATA    105,   102,   103,    45,    68,    97,   110,   105,   742
330 DATA    115,    32,    80,   117,    98,   108,   105,   115,   778
340 DATA    104,   105,   110,   103,    32,    67,   111,   114,   746
350 DATA    112,    44,    13,    10,    10,    36,    34,    82,   335
360 DATA    111,    98,   101,   114,   116,    32,    74,    44,   464
370 DATA     32,    72,   117,   109,   186,   101,   100,    83,   731
380 DATA    101,   105,   109,   101,   110,   114,    32,    80,   752
390 DATA     87,   114,    97,   103,   114,    97,   112,   104,   838
400 DATA    115,    32,    32,    32,    32,    80,   114,   111,   548
410 DATA    103,   114,    97,   109,    13,    10,    34,    67,   549
420 DATA     76,    77,    77,    65,    78,    68,    46,    67,   557
430 DATA     79,    77,    40,    85,   110,   107,   110,   111,   719
440 DATA    119,   110,    41,    48,    79,   114,   101,   101,   496
450 DATA     41,    32,    32,    32,    32,    32,    32,    32,   345
460 DATA     36,     0,     0,   104,     3,     1,   100,     9,   415
470 DATA    205,    33,   100,    48,   205,    33,    48,     3,   767
480 DATA    114,     4,   254,     6,   130,     1,    51,   210,   787
490 DATA    142,   105,    30,   120,    62,     0,     0,    77,   642
500 DATA    116,     3,    67,   235,   243,   139,   195,    64,  1042
510 DATA     30,   139,    14,     1,     0,    56,   163,   117,   561
520 DATA    241,   139,    22,     2,     0,   252,   191,   213,  1048
530 DATA      2,    30,   139,    14,     1,     0,   168,   137,   461
540 DATA      1,    18,   192,   116,    17,   294,   288,    13,   801
550 DATA    201,   116,     6,   130,    53,    58,   208,   110,   896
560 DATA     25,   131,   166,    17,   235,   235,   254,     0,  1102
570 DATA    137,     1,   136,   103,    11,   201,   117,     3,   882
580 DATA    136,   165,    64,   137,     5,   199,    69,     2,   818
590 DATA      9,     0,    30,   139,    54,     3,     0,    67,   301
600 DATA    139,   195,     3,   222,     1,   117,     2,   198,   869
610 DATA    123,     1,    11,   201,   317,     6,   185,     6,   650
620 DATA      0,   235,    23,   144,    59,   163,   117,    87,   860
630 DATA     30,   136,    54,    60,     0,   128,    62,   137,   410
640 DATA      1,     1,   137,    20,   190,   183,     1,   185,   610
650 DATA     11,     0,   131,   199,     4,    14,     7,   243,   600
660 DATA    184,   176,    36,   178,    14,    31,   239,    69,   891
670 DATA    128,    62,   130,     1,     0,   116,    48,    70,   571
680 DATA     88,    31,    56,    14,     1,     0,   117,    39,   347
690 DATA     70,    88,    31,    51,   246,    70,    78,   173,   885
700 DATA     11,   192,   117,   258,   173,   139,   238,    77,  1197
710 DATA    172,    16,   162,   117,   251,    78,   139,   204,  1165
720 DATA     78,    56,   245,   116,     5,   128,    60,    92,   703
730 DATA    117,   246,    78,    43,   206,   235,   187,    14,  1110
740 DATA     31,   185,     6,     0,   196,   114,     1,   235,   745
750 DATA    177,   142,   165,    56,   210,   116,     3,   233,  1143
760 DATA     67,   255,   186,    71,     1,   188,     0,   205,   974
770 DATA     33,   196,   213,     2,   138,    14,   137,     1,   728
780 DATA     58,   237,   232,    25,     0,   232,    22,     0,   798
790 DATA    136,   214,   188,     6,   205,    33,   131,   168,  1186
800 DATA     13,   188,   188,     1,   188,     9,   209,    33,   727
810 DATA    226,   232,   188,    76,   205,    33,   173,   232,  1357
820 DATA      0,     0,   186,   126,     1,   188,     9,   205,   718
830 DATA     33,   165,    80,   138,   196,   232,     1,     0,   875
840 DATA     80,    80,    81,   177,     4,   210,   232,    89,   841
850 DATA    232,     3,     0,    80,    36,    15,     4,   144,   522
860 DATA     39,    28,    44,    39,    82,   138,   208,   190,   776
870 DATA      2,   205,    33,    90,   195,     0,     0,     0,   925
```

PCMAP.BAS: *A BASIC program that will automatically create PCMAP.COM.*

ident routines above it down in memory to fill the hole, rerouting all appropriate interrupt vectors to the modified addresses, and altering any references to absolute addresses. Unfortunately, that's next to impossible. If you have to purge a set other than the one most recently loaded, run REMOVE as many times as necessary to regress to the one targeted, then reinstall the ones above it.

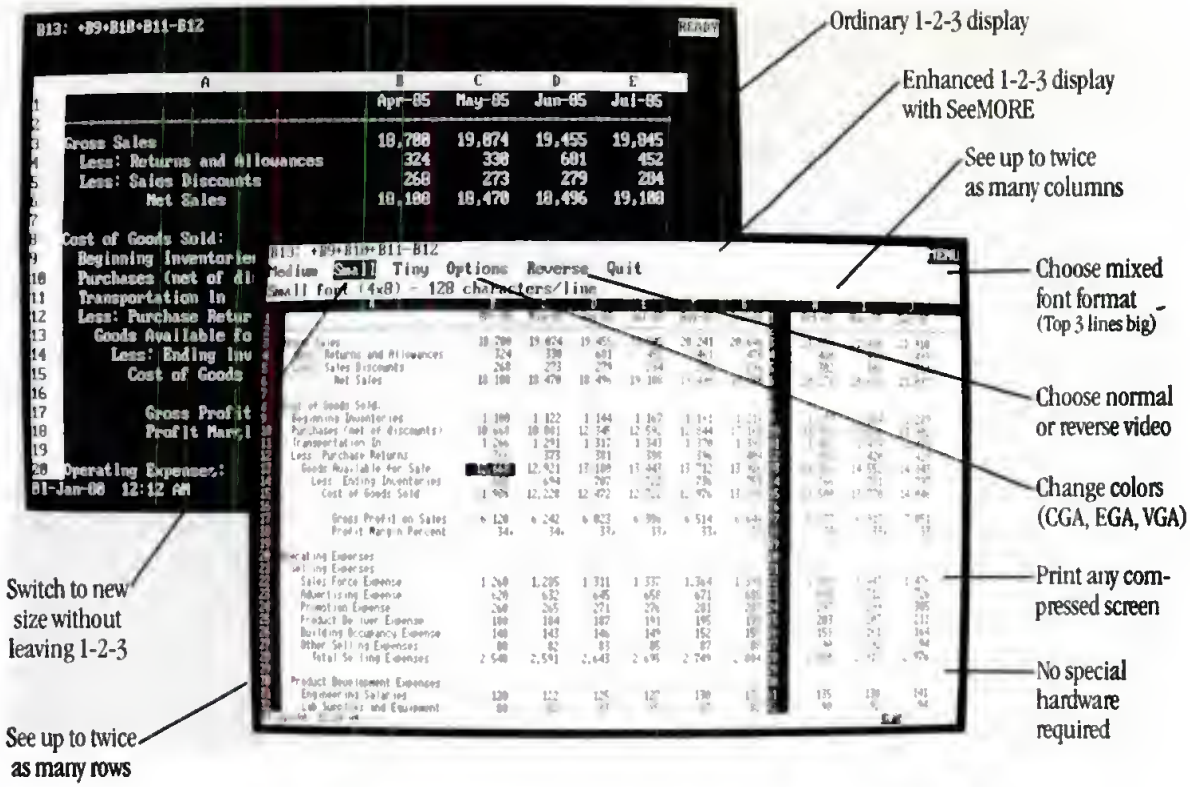
It's also legal to run REMOVE immediately after INSTALL, with no TSRs loaded in between. The wedge left by INSTALL will be erased. In fact, although there's no obvious reason to do so, you can run INSTALL several times in succession, then reverse the action a layer at a time. You may also run other applications, if you prefer, between the time INSTALL is invoked and a TSR is loaded.

In the unlikely event that you encounter a "Deinstallation failed" warning in the course of removing a TSR, you should probably reboot the system. It's *possible* you might encounter no adverse side effects without the reset, but it's also possible that down the road somewhere (and at the worst possible time) execution might skid to a halt with a critical memory allocation error.

THE METHOD The premise of INSTALL/REMOVE is simple: immediately below each group of memory-resident utilities is a 1600-byte layer of resident data left behind by INSTALL that retains, among other things, the entire interrupt vector table as it appeared before the TSR group was loaded. When REMOVE is called on to eliminate the topmost set of TSRs, it locates the highest wedge, copies the contents of the vector table stored inside it into the real vector table, and frees all memory used by the wedge and everything loaded after it.

The most difficult task is to determine which memory blocks to free up. Every TSR initially owns two memory blocks: one for its copy of the environment, and one for its PSP (short for Program Segment Prefix), code, data, and stack. (For more details on how DOS loads a program, refer to the sidebar "Behind the Scenes with EXEC.") I'll refer to the former as the "environment block" and the latter as the "PSP block" hereafter.

One potential complication is that a TSR may have additional data blocks allocated to it if it explicitly requested them with DOS function 48h. Moreover, TSRs



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■ PC LAB NOTES

DOS MEMORY MANAGEMENT

The DOS memory management scheme is one of moderate sophistication that lends itself well to use by applications programs. Nearly all memory is divided into a number of blocks whose length can theoretically range from 16 bytes (one paragraph) to 1 megabyte. Each block of allocated memory is preceded by a 16-byte memory control block that contains important information concerning, among other things, the length of the block and its current allocation status.

DOS provides three memory allocation/deallocation functions. Accessed through interrupt 21h, they are as follows:

48h	Request a memory block
49h	Free a block allocated through function 48h
4Ah	Modify a block received through function 48h

The ground rules for a program claiming and discarding blocks of memory are simple: any free space can be reserved through DOS function 48h, and any block reserved can be released through function 49h or modified in length with function 4Ah.

There are several reasons why an application might want to make use of these memory allocation services. A .COM file is allocated every byte of memory available in the system when it's loaded, although such files rarely use more than one 64K segment. A well-behaved .COM file (and one that wants to work in an environment like *Windows*) should release the unneeded memory when it first receives control. Conversely, programs sometimes need additional memory for data storage or buffering. Getting it is as easy as calling DOS function 48h with the size of the requested block (in paragraphs) stored in BX.

You might think that if two consecutive blocks were requested and allocated, and this was followed by a call to function 49h to free the first (lower) of the two, both would come free. Fortunately, that doesn't happen. If it did, REMOVE couldn't deallocate the memory dedicated to a TSR whose environment block didn't immediately precede its PSP without destroying everything in between. Blocks can be deallocated in any order, regardless of the order in which they were reserved.

The operating system will allow holes to develop in memory and can deal with them quite elegantly. It appears that while DOS will never locate the PSP block of a program inside a hole, it's perfectly willing to place environment blocks there. It will also parcel out an island of unclaimed memory to satisfy a program's function 48h request.

—Jeff Prosise

frequently choose to conserve memory for other programs by deallocating their own environment blocks before termination.

To complicate matters further, only the PSP blocks are guaranteed to be located physically above the wedge in memory. A removal utility must locate all of the blocks, verify that they belong to the TSR, and then deallocate them with function 49h. DOS provides no documented way of doing that. But as we'll see later, REMOVE has a unique way of finding memory blocks and determining who owns them.

THE INSTALL UTILITY INSTALL's role in the deinstallation scheme is twofold: it saves a copy of the interrupt vector table before that gets altered by a subsequent TSR, and it also saves the segment addresses of its own environment and PSP blocks. The PSP is the 256-byte header that DOS builds in front of every executable program when it is loaded into memory. The PSP memory block will be larger than 256 bytes since it also contains the program's code and data.

INSTALL has to stash away a copy of the entire 1024-byte interrupt vector table simply because it has no way of knowing exactly *which* vectors the next TSR will borrow. With the whole table saved, REMOVE can disable a routine by replacing the current vector table (including patches made by the last TSR) with a copy of it as it appeared before the latest TSR was made resident.

■ A removal utility must locate all of the blocks, verify that they belong to the TSR, and then deallocate them with function 49h.

INSTALL next stores the pair of segment addresses that denote its own location in memory. It pulls its own PSP segment value right out of the CS register. The CS register of a .COM file is always coincident with the PSP segment upon entry. The segment address of its environment block is stored and accessible at offset 2Ch inside the PSP.

What INSTALL can't tell is where in memory DOS will load the next executable program. True, INSTALL could make an educated guess, based upon its own length and the length of its environment block, but any serious attempt to predict the exact address could be thwarted by a number of factors. Changing a PATH string, for example, could alter the length of the environment block inherited by the next program. And if more than one TSR is loaded after INSTALL, INSTALL can't even begin to guess where the second or third will go. The somewhat difficult task of determining where they're located is left to REMOVE. But the two segment values saved away by INSTALL are critical to that determination.

The two segment addresses must be deposited where REMOVE can find them later. To that end, the very first time INSTALL is run, it sets up a table in memory

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■ PC LAB NOTES

BEHIND THE SCENES WITH EXEC

When the DOS command processor wants to load a file for execution, it calls the built-in EXEC function to do the dirty work. Among the many tasks to be taken care of is reserving a portion of memory for the new resident. EXEC requests the memory in two distinct phases.

First comes the area to be set aside for the program's environment block. The environment block holds a set of strings inherited from the master environment block in low memory, strings like the path to the command processor and text of the current command path defined with the PATH command. This block is typically small (160 bytes or less), but can be larger. DOS 3.2, in fact, sets the maximum size to 32K.

The second block requested is for the file itself. A PSP is built at offset 0 in the new block, and this is followed by the code and data that make up the program itself. If the program is a .COM file, this block constitutes all of remaining memory since DOS has no way of knowing up front just how much memory the program will require. If it's an .EXE, the block will consume only the amount of memory specified in the file header.

If all allocated memory comprises one contiguous block, DOS locates a program's environment block immediately before its PSP block. But if there is a large enough hole in memory, DOS will stuff a copy of the environment strings there. These holes frequently develop when a TSR deallocates its own environment block before becoming resident. Then (provided the size of the environment doesn't change) DOS will separate the next environment block and PSP block.

Contrary to popular belief, EXEC doesn't always explicitly use functions 48h and 4Ah to manipulate memory. DOS 3.2, for example, appears to forgo the functions in favor of either jumping directly to them (without executing an interrupt 21h) or manipulating the memory control blocks itself. The DOS 2.*x* EXEC is more faithful about using its own internal services but still doesn't use them in all cases.

Your own applications can use the EXEC function to invoke another program, just as DOS does. The function number is 4Bh, and it is accessed through interrupt 21h. Be warned, however, that this is one of the most complex DOS functions: the parent program must pass the addresses of an environment block, a command tail, and two file control blocks to the child process. The most comprehensive treatment of the EXEC function is contained in Ray Duncan's *Advanced MS-DOS*, a relatively new offering from Microsoft Press. If you want to experiment with EXEC, this is *the* book to buy, and it will prove an invaluable resource in other areas, as well.
—Jeff Prosise

called the Installation Data Table, or IDT. The IDT stores two vital pieces of information: the number of installations recorded and the two segment addresses of each wedge's environment and PSP blocks.

The reasons for maintaining a count of the TSRs installed is probably obvious. For one thing, INSTALL has to know when its internal limit of 32 TSRs is reached. For another, REMOVE has to know when there are none left. More important, the count is used as an index into the IDT when segment values are stored or retrieved. Since up to 32 wedges can be present at once, care must be taken not to overwrite the segment values stored for one with those of another.

The IDT has 64 words (enough, that is, for 32 pairs of segment values) set aside to record the segment addresses of each INSTALL wedge. The 64-word area retains them in staggered order. The first word is the PSP block segment of the first wedge, the second is the environment block segment of the first wedge, the third is the PSP block segment of the second wedge, and so on. When REMOVE wants to locate a set of segment values, all it has to do is obtain the number of installations, multiply by 4, then use the result as a pointer into the table.

Creation of the IDT presents a couple of problems. First, it has to be located where it won't be destroyed by DOS. Second, both INSTALL and REMOVE must be able to find it.

The IDT is set up inside the first INSTALL wedge made resident. Every time it is called to record a new installation, INSTALL leaves behind a portion of itself in memory. Each one of these wedges contains room for an IDT. Only the space inside the very first one is used, however. Any time the program is run thereafter, it does its usual job of obtaining the two required segment addresses. But these addresses aren't stored within the current code segment; they're placed in the area that was reserved when the *first* INSTALL terminated.

To make the IDT accessible to an external program, INSTALL chains an additional function to the BIOS time-of-day service interrupt. Interrupt 1Ah normally has only two functions defined, numbered 0 and 1. INSTALL adds function 44h. If an interrupt 1Ah is executed with AH set to 44h and at least one copy of INSTALL is resident, the segment of the IDT is returned in the ES register. To know if the IDT does exist, then, the calling routine monitors the value of the BH register before and after the call. If the IDT is present, BH is decremented by 1; if it's not, BH returns unchanged.

THE REMOVE UTILITY When REMOVE is called upon to purge the last group of TSRs, it uses the groundwork laid by INSTALL as its foundation. It first calls interrupt 1Ah, function 44h, to verify that at least one utility (or group of utilities) is resident in memory. Then it prints the number of installations. A complete list of everything installed is printed, and the user is asked to verify that the deinstallation should proceed.

All REMOVE has to do to obtain the list of names of the utilities installed is to retrieve the address of each wedge from the Installation Data Table. It can then

look inside each one to see what was entered on the command line. Everything entered on the command line when a program is invoked is deposited by the operating system into a buffer beginning at offset 81h in the program's PSP. The byte at offset 80h holds the number of characters entered. Each time INSTALL runs and exits through interrupt 27h, the PSP is left behind.

The IDT is accessible because when function 44h was initially called to see if any utilities were installed, ES addressed the table on return. REMOVE begins the deinstallation process by pulling the segment address of the most recently inserted wedge's PSP block from the IDT. The vector table in low memory is replaced with the contents of the vector table stored in the wedge. The only precaution to take here is to make sure that an interrupt doesn't occur while the table is being altered. Before reading the vector table, REMOVE disables interrupts with CLI before making changes, just as INSTALL does. (You can imagine what might happen if, say, a timer interrupt was generated by the system at the same time that its interrupt vector was being modified. Execution would jump off to some random place in memory, probably crashing or locking up the system as it went.)

Two of the segment addresses needed to start the memory deallocation process are immediately available: those of the environment and PSP block of the wedge. Both are stored in the IDT. But determining where DOS located any TSRs loaded after the wedge isn't quite so easy. For lack of a more reliable way, REMOVE turns to the chain of memory control blocks that define the current structure of memory.

The memory control block for the wedge's PSP lies in the paragraph preceding the PSP itself. (A paragraph is a 16-byte region of memory; for more on control blocks, see the sidebar "Tracking Memory: DOS Memory Control Blocks.") Since it already knows the address of that PSP block, REMOVE taps into the chain at that point and uses it as a springboard to the memory blocks located above it.

Everything else REMOVE does hinges on a single assumption: that regardless of where DOS locates the various memory blocks that comprise TSRs loaded after INSTALL, all of their associated PSP blocks will reside at addresses above INSTALL's PSP block. That's the only way REMOVE can determine if a TSR was loaded after INSTALL. Fortunately, this is a safe assumption. Memory blocks can be located below INSTALL only if DOS finds a hole to fill when it loads the TSR. But such holes are fair game only for environment blocks or separately allocated data blocks; PSP blocks are never placed there.

TRACKING MEMORY: DOS MEMORY CONTROL BLOCKS

To keep track of memory allocation, DOS Versions 2.0 and later build a 16-byte memory control block immediately before each discrete block of memory. Although the format of the control block (also known as an arena header, borrowing from UNIX terminology) is officially undocumented by Microsoft, information about it has been published in a handful of reliable periodicals and reference books.

It turns out that only the first 5 bytes in the control block are used. The first byte will always have the value 4Dh or 5Ah. The value 5Ah indicates that the header is the last in the chain; all memory above it is unused. Hex 4D means that the control block is intermediate in the chain; the memory directly above it usually belongs to a program or, perhaps, to DOS itself.

The next two bytes hold the PSP segment address of the program that owns the corresponding block of memory. A value of 0 means the memory block is free to be claimed by someone else; any other value represents a segment address. An inspection of memory control blocks with DEBUG reveals that a program "owns" its own PSP block, its environment block, and any memory it sets aside through function 48h.

Bytes 3 and 4 (the fourth and fifth bytes in the header) indicate the size (in paragraphs) of the memory block. If you know where to find one control block, you can find the next one by adding the length of the memory block plus 1 to the segment address of the control block. Thus the memory control blocks are linked logically together, and, by scanning the chain, DOS gets a snapshot of the current memory structure.

Finding the first control block in the chain can pose a problem, however. DOS maintains a record of its address, but where the record is located depends upon the version of DOS, whether or not a hard disk is installed, and sometimes even the type of machine you're using. An easier (though not statistically foolproof) way is to begin at the bottom of memory, searching for a paragraph whose first byte has a value of 4Dh and that holds the segment address of the next paragraph in the word at offset 1. You can see an example of this in REMOVE.COM. It works because the first memory block (which belongs to DOS and will be located somewhere above segment 50h) "owns" itself.

Knowing this, a program can similarly peruse the chain and determine critical allocation information for itself. That's exactly what REMOVE does to determine where the TSRs loaded after INSTALL were located by DOS. Since INSTALL stored away its PSP segment address, REMOVE can retrieve it, then subtract 1 from it to address the memory control block that precedes INSTALL's PSP block. From there, it's a short jump forward to the next control block and the one after it.

It's reasonably safe to examine the chain of memory control blocks for information. But altering them yourself without benefit of the DOS services is extremely dangerous. If DOS determines that the chain has been corrupted, it responds by halting the system and displaying the message "Memory allocation error." The only recourse at that point is to reboot, sacrificing any data stored in RAM in the process.—**Jeff Prosise**

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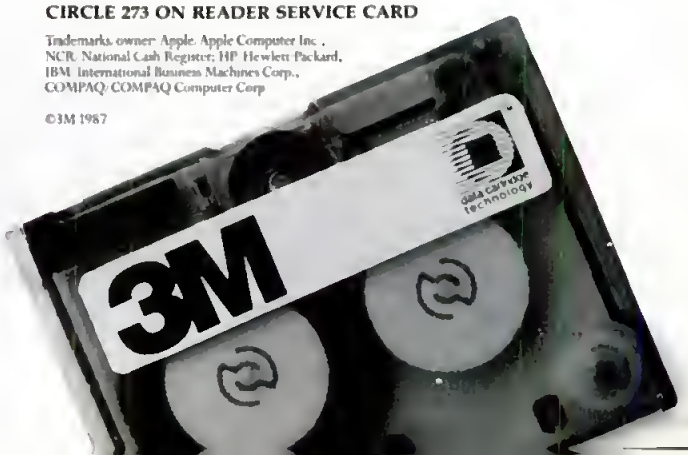


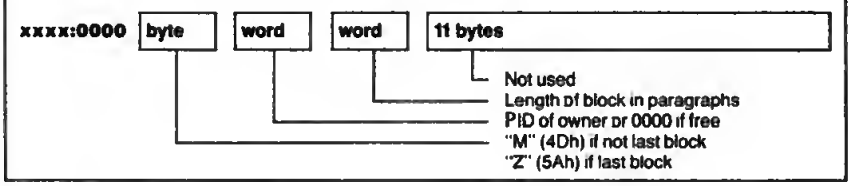
■ PC LAB NOTES

A MEMORY-MAPPING UTILITY

With so many terminate-and-stay-resident (TSR) utilities and permanent command shells in use today, it's often helpful to know just which programs *are* installed in your PC's memory and how much RAM they occupy. CHKDSK will report the number of free bytes of RAM, but it won't show what programs are loaded. My PCMAP utility is designed to do just that. It displays a list showing the name of each program (or process) and how many bytes of memory are allocated to it.

PCMAP works by tracing the chain of Memory Control Blocks (MCBs) that DOS uses to subdivide memory between different processes. Each MCB is like a 16-byte bookmark that identifies how much memory follows it, which process owns the memory, and whether it is the last MCB or not. (See Figure A.) Byte 0 of an MCB contains the letter "M" (4Dh) if it is not the last MCB in the chain, or "Z" (5Ch) if it is the last block. Bytes 1 and 2 form a word (stored as low byte–high byte) that identifies the "owner" of the memory following the MCB. This 4-digit hex number is called the Process ID (PID). For current versions of DOS, the PID is simply the Program Segment Prefix (PSP) segment address of the program that allocated the memory. Bytes 3 and 4 form a second word, which contains the number of paragraphs

Figure A: The Structure of a DOS Memory Control Block




```
                    ;Get the aegment of the current copy of COMMAND.COM
                    ; aa atored in the INT 2Eh vector.

-D 0000:00BA L 2
0000:00B0                                       97 0B                       ..

                    ;The memory control block ia located at the previous
                    ; paragraph: B97 - 1 = B96.  Diaplay the MCB.

-D 0B96:0000 L 10
0B96:0000  4D 97 0B D3 00 00 00 00-00 00 00 00 00 00 00 00   M...............

                    ;Byte 0 = 4Dh, indicating a MCB.  Bytea 1 and 2 form
                    ; the word indicating the owner (0B97 in thia caae).
                    ; Bytea 3 and 4 form a word ahowing the length of the MCB
                    ;(MCB addreaa + 1) + (length of block) = next MCB

-H B97 D3
0C6A  0AC4
                    ;Show aum and difference.  Uae the aum.
                    ;Diaplay the next MCB.

-D 0C6A:0000 L 10
0C6A:0000  4D 7A 0C 03 00 00 00 00-00 00 00 00 00 00 00 00   Mz..............

                    ;Calculate the addreaa of the next block aame way.

-H C6B 3
0C6E  0C68
-D 0C6E:0000 L 10
0C6E:0000  4D 97 0B 0A 00 00 00 00-00 00 00 00 00 00 00 00   M...............
```

(continues)

Figure B: *A DEBUG session that traces the MCB chain.*

So REMOVE begins a scan of the memory blocks above INSTALL's PSP block, looking for other PSP blocks. A PSP block is identified by a unique characteristic: it owns itself. In other words, the segment address held at offset 1 inside its control block points back to the PSP itself. The segment value stored in an environment block's control block, on the other hand, points to an address different from its own.

When a PSP block is found, REMOVE records its segment address and begins another scan of DOS's memory control block chain, this time starting at the very first control block in memory. Then it deallocates any block it runs across whose owner (as recorded in its control block) is the PSP block just noted. The scan ends when REMOVE reaches a control block whose first byte is 5Ah, the value that identifies it as the last in the chain.

To put it another way, when REMOVE finds a PSP block located anywhere above INSTALL's own PSP block, it has found the core of a TSR that was loaded after INSTALL. Any other block that belongs to that TSR, no matter where in memory it is, can be identified by examining its control block for the segment address of the TSR's PSP block.

With one deallocation loop complete, REMOVE continues its search for PSP blocks right where it left off. Blocks other than PSP blocks are simply passed over at this point. If one that's skipped is actually an environment block that should be deleted, REMOVE will come back and get it later, after it has found the corresponding PSP block.

The search ends when the PSP block most recently encountered is REMOVE's own PSP block. REMOVE's PSP block will always be higher in memory than any TSR's PSP block, since the order of PSP blocks reflects their order of entry. The space allocated to REMOVE itself is reclaimed by DOS when the program terminates.

REMOVE finishes up by freeing the environment and PSP blocks of the wedge

```
                    ;Each block is a link in the chain.  Dos traces this
                    ; chain each time it regains control.

-H C6F A
0C79  0C65
-D 0C79:0000 L 10
0C79:0000  5A 7A 0C 86 73 00 00 00-00 00 00 00 00 00 00 00   Zz..s...........

                    ;The 5Ah indicates that this is the last block in the
                    ; chain.  The address total should be the end of memory

-H C7A 7386
0000  90F4

                    ;0000h = 512k (in my machine).  Quit DEBUG.

-Q
```

(Figure B ends)

```
                    ;Load any program under DEBUG (I used COMMAND.COM).
                    ; You must use a version of DOS 3.0 or later.

A>DEBUG COMMAND.COM

                    ;Display the word containing the segment address of the
                    ; programs copy of the environment.
-D 2C 1 2
120E:0020                                       7F 09                    ..

                    ;Display the program's copy of the environment.  If you
                    ; don't see the name (because your environment is larger,
                    ; enter the D command a few more times with no arguments
                    ; until the program name appears.  Then quit DEBUG.

-D 097F:0
097F:0000  50 41 54 48 3D 00 43 4F-4D 53 50 45 43 3D 41 3A  PATH=.COMSPEC=A:
097F:0010  5C 43 4F 4D 4D 41 4E 44-2E 43 4F 4D 00 00 01 00  \COMMAND.COM....
097F:0020  43 4F 4D 4D 41 4E 44 2E-43 4F 4D 00 00 00 00 00  COMMAND.COM.....

-Q
```

Figure C: *A DEBUG session for finding a program name.*

of memory allocated to that particular MCB by the operating system. (Note that the MCB itself is not included in the count.) The remaining 11 bytes are not used by current DOS versions. For this reason, they may contain values left over in memory from other programs.

The sample interactive DEBUG session shown in Figure B illustrates DOS MCBs and how they are chained. While the actual addresses of the MCBs and their lengths will differ for other systems, the procedure remains the same. After studying the example, you can trace right through your computer's memory.

First, make sure that DEBUG is in either your current directory or path and enter DEBUG at the DOS prompt. Once DEBUG has loaded and displayed its prompt (a hyphen), you can follow the procedure to find your own memory chain.

One interesting thing about PCMAP is its ability to display the names of some of your TSR programs. When a program is loaded, DOS also gives it a copy of the DOS environment, which is a collection of strings of the form *NAME=value*, followed by a zero-byte (ASCII-Z). The segment address of the program's copy of the environment is stored in the word at offset 2Ch in the program's PSP. In DOS Versions 3.0 and later the full pathname of the program is stored at the end of the environment. PCMAP checks to see if the environment block is owned by the program and, if so, copies the name to the screen. (Running PCMAP under versions of DOS prior to 3.0 will show "(Unknown)" for the program name.) Figure C is a sample DEBUG session that finds a program name.—**Robert L. Hummel**

Robert L. Hummel is senior technical editor on the staff of PC Magazine.

itself. With all targeted memory blocks deallocated, the TSRs are effectively erased, since subsequent files will be loaded over them.

If the carry flag is set on return from any call to function 49h—which would indicate that the deallocation request made by REMOVE was rejected by the operating system—execution branches to REMOVE's error-handling routine (labeled MEM_ERROR in the assembly language source code listing REMOVE.ASM). A "Deinstallation failed" message is issued, warning you of potentially unstable circumstances ahead. But upon successful completion, REMOVE bids you a warmer adieu: "Deinstallation completed."

IN CLOSING INSTALL and REMOVE are two of the most used utilities in my personal library. I like to use *SideKick* regularly but frequently need to get rid of it when developing and testing resident code of my own. The ability to shelve it without rebooting the computer is just what the doctor ordered.

By studying the source code for INSTALL and REMOVE, you can get a fair amount of insight into DOS's memory management methods. Thanks to the efforts of a multitude of programmers throughout the user community, the subject is now pretty well understood. One good way to see how DOS stacks your programs is to make use of the mapping utility provided by Robert L. Hummel in the sidebar "A Memory-Mapping Utility." You will probably be surprised to see just how a stack of resident utilities can tangle things up.

Resident utilities may someday implement a standard header that contains the information needed to deallocate them. Until that day [*probably the eschaton—Ed.*] you can make use of INSTALL/REMOVE to keep your system running smoothly. Utilities are a key to productivity, and increased productivity is the primary justification for PCs in the first place. PC

Jeff Prosise is a frequent contributor to PC Magazine.

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- Transactions . . . No Limit**
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- Inventory Items 999
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- most reports can be exported to Lotus®, ASCII or DIF files

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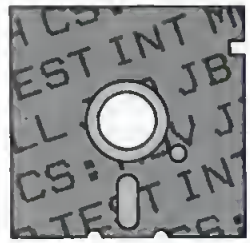
■ **PROGRAMMING/UTILITIES** ■ MICHAEL J. MEFFORD

DOING WHAT DIR DOESN'T



DR.COM lets you sort files by extension, size, date, time, and DOS order—and view, rename, move, and delete them—without ever typing DIR again.

As a file management tool, DOS is a dull knife. When you spot an unfamiliar filename in a DIR listing and stop and TYPE *filename* to examine it, you lose your place. If the file is OK after all, you have to hit DIR again. If not, it's DEL *filename* or, to move the file to another directory, you must type COPY *filename \dirname*, followed by DEL *filename*. And another DIR. Little wonder no one has the time and patience to keep his hard disk in order.

DR.COM will change all that. When you simply enter DR at the DOS prompt, you'll quickly get an alphabetically sorted, DOS-format listing of your current directory, and on the right of the screen you'll find a menu full of the file functions you'll need. A movable highlight bar controlled by the keypad cursor keys lets you thumb forward and backward through the directory. Park the bar on a file of interest, hit the appropriate function key from the menu list, and DR will either pop up the file for viewing, delete it, or rename it.

By adding parameters, you can sort the initial DR directory display in five different ways. Its full syntax is

```
DR [d:][directory][/E]|/S]|/D][/T]|/O]
```

The switch characters (a slash followed by a letter) tell DR which way it should sort your directory. DR defaults to sorting by filename, essentially alphabetizing the listing. The /E switch instructs DR to sort by Extension. /S sorts by Size and either /D or /T sorts by DaTe. If you want to see a directory's filenames listed in the DOS DIR order, just put /O on the command line. Don't worry if you can't remember the switches. All the sort functions (except O) are also listed in the DR menu.

Unlike DIR, which scrolls off into never-never land, DR gives you complete control over the directory listing display. The Up and Down Arrow keys scroll the highlight bar a line at a time, while PgUp and PgDn flip to the next group of 21 filenames that DR displays at once. Ctrl-PgUp and Ctrl-PgDn take you to the top and bottom of the current page, and the Home and End keys take you to the beginning and end of the directory.

DR has an additional search feature that quickly puts the highlight bar on the first filename that starts with a particular character. With a DR display on the screen, pressing "P" will take you to the first filename that begins with the letter "P," for example. Successively pressing "P" will take you forward through all the filenames that begin with that letter. If you've sorted by anything but the default alphabetized listing, this can be a quick way to find a particular file.

FULLY FUNCTIONED DR takes advantage of all ten function keys. F1 through F6 control the action taken on the

The DR screen menu with a typical page of directory listings.

highlighted filename. If you press F1 (or the Enter key), the currently highlighted file is instantly brought on-sereen for viewing. Once inside the file, the Up and Down Arrows continue to scroll the display one line at a time, and PgUp and PgDn move you to the previous or the next page. Either Ctrl-PgUp or Home takes you to the top of the file and, as you would expect Ctrl-PgDn or End puts you at the bottom of the file.

When you're through viewing, another tap on F1, or the Enter key or the Esc key, exits back to the menu. Indeed, as it should in all applications, each press of the Ese key takes you back one step in each DR module. Pressing Esc from the directory listing returns you to the DOS prompt. You can thus pop in and out of files for perusal with a minimum of keystrokes and never again have to resort to the DOS TYPE command or, for that matter, be bothered with typing the name of the file.

If you decide the file you just viewed is ready for the boum of no retum, press F2 to delete it. As a check, before deleting the highlighted file, DR requests verification—"Y" to confirm that the file should be deleted, "N" or Ese to cancel your delete command. If you don't want to be queried each time, you ean press F5 to eliminate the confirmation step. (F5 is an on-off toggle; the default is Confirm ON.) If you tum Confirm OFF and press F2, the deletion is instantaneous. After deleting a file, DR tidies up by removing the filename from its listing and decrementing the file count it displays.

F3 lets you Rename a file and F4 is to Move a file to another directory. When you press F3, you are prompted for a new name for the highlighted filename. Your response cannot contain the path characters ":" and "\" nor the wildcard characters "?" or "*". Once you have entered the desired new name, press Enter. If you have christened the file with a valid name, the new name will replace the old one both on the disk and in the DR listing. Otherwise, you probably entered an invalid filename character such as space and DR will complain with that annoying beep. If you pressed F3 and wish to change your mind in midstream, hit the dependable rip cord, the Esc key.

F4, Move a file to another directory, is particularly useful if you use one directory as a dumping ground for files that must later be sorted into their appropriate cubhyholes. When you press F4, you are prompted for a new directory for the highlighted file. Note that you cannot move a file to another drive, nor can you move to a directory that already has a same-named file. The latter entails copying, a function that is not included in DR. If you want to move a file to another directory and also give it a new name, first press F3, Rename the file, and then F4, Move. Confirmation of a successful move is the same as when you delete a file. The name will be removed from the directory listing. Don't panic. Your file is not lost, just in the new directory, where you wanted it.

■ You can pop in or out of files for perusal with a minimum of keystrokes and never again resort to the TYPE command or be bothered with typing the name of the file.

F6 is the *WordStar* toggle. *WordStar* and some other word processors set the high bit of an ASCII character on to control page formatting, causing a normal text character to be displayed as a graphics character. DR by default strips this high bit so that even these text files will look normal when using the View function. However, if the file you wish to view has graphic characters you wish displayed as graphic characters, press F6 and the "ON" next to *WordStar* will be toggled "OFF", and DR will leave the high bit alone. The *WordStar* toggle does the same thing as Ctrl-QG in *SideKick*'s Notepad.

The last four functions of DR control the different ways you can Sort the directory listing. These functions are F7, Sort by Name; F8, Sort by Extension; F9, Sort by Size; and F10, Sort by DaTe. Unlike the DOS SORT.COM, the Date sort correctly handles the old problem of sorting by year as well as month, date, and finally time. You might use F8, Sort hy Extension, if you were just interested in your .BAK files, for example.

The Sort functions can he used in combination with other functions. For example, if you want to see the latest file updates, press F10, Sort hy DaTe, and immediately press End to take you to the end of the listing. Or if you want to see all your .COM files sorted hy size, press F7, Sort by Size, and then F8, Sort by Extension.

All the DR functions except Confirm will also accept a Ctrl-letter command entry. This means that while depressing the Ctrl key you have the option of pressing V (or Enter) to View, D to Delete, R to Rename, M to Move, W to toggle the *WordStar* high hit, N to sort hy Name, E to sort hy Extension, S to sort hy Size, and T to sort hy daTe. Confirm was omitted from the Ctrl-letter alternative to help protect against accidental deletion.

An additional touch I think you'll appreciate is that the Delete, Rename, and Move functions work directly while you are Viewing a file. For example, if while in View mode you decide that the file should go, instead of returning first to the menu with Esc, just press F2 and you will be automatically returned to the menu's confirm deletion prompt. (This assumes the Confirm toggle is "ON". If "OFF", DR will not pause before deletion.)

GETTING DR If you haven't yet bought a modem, DR.COM should push you to the decision point. At roughly 3K, it's considerahly the largest utility *PC Magazine* has presented to date, and accurately typing in either DR.ASM (Figure 1) or DR.BAS (Figure 2) may prove rather difficult. The .COM, .ASM, and .BAS versions of DR are easily downloaded by modem from the PC Magazine Interactive Reader Service, however. See the accompanying sidebar for instructions.

APPLICATION NOTES I think you will find many other everyday uses for DR aside from cleaning up a directory. First of all, you will probably want to use DR as a replacement for the DOS DIR com-

```
;           DE.asm
;  Format:  DR [d:][directory][/E[/S][/D][/T][/O]

CODE SEGMENT                        ;*************************;
ASSUME CS:CODE,DS:CODE              ;*                       *;
ORG 100H                            ;*  REMEMBER TO EXE2BIN  *;
                                    ;*                       *;
START:          JMP     BEGINNING   ;*************************;

;               DATA AREA
;               ---------
;               DB  'Copyright 1987 Ziff-Davis Publishing Co.'
;               DB  'Michael J. Mefford'

CURRENT_DISK    DB  ?
STATUS_REG      DB  ?
VIDEO_SEG       DB  0B000H
NORMAL          DB  07E
INVERSE         DB  70E
BAR_ATTRIBUTE   DB  70H
CURSOR_TYPE     DB  ?

SORT_OFFSET     DB  8
SORT_TABLE      DB  8,12,9,3,13,0,29
SORT_FLAG       DB  0
CUR_OFFSET      DB  BUFFER
CUR_FILE        DB  ?
END_OFFSET      DB  ?
PAGES           DB  ?
PAGE_END        DB  21*160+320
COUNT           DB  1
LINE            DB  320
STAR_DOT_STAR   DB  '*.*',0
VERIFY_FLAG     DB  1
WORDSTAR_BIT    DB  7FH
SEARCH_COUNT    DB  ?

DISPATCH_KEY    DB  1,11E,12H,13H,16H,1CH,1FH,20E,21H,310,32H,3EE,3CH,3DH,3EH
                DB    3FH,60E,61E,62E,63E,66E,67E,68H,69H,6FH,5EH,51H,76E,88H

DISPATCH_TABLE  DB  EXIT, WORDSTAR, SORT_EXT, RENAME, SORT_DATE, VIEW
                DB  SORT_SIZE, DELETE, VIEW, SORT_NAME, MOVE, VIEW
                DB  DELETE, RENAME, MOVE, VERIFY, WORDSTAR, SORT_NAME
                DB  SORT_EXT, SORT_SIZE, SORT_DATE, HOME_BAR, UP_ARROW
                DB  PG_UP, END_BAR, DN_ARROW, PG_DN, BOTTOM_BAR, TOP_BAR

VIEW_TABLE      DB  HOME_FILE, UP_LINE, UP_PG, END_FILE
                DB  DN_LINE, DN_PG, END_FILE, HOME_FILE

DISPLAY_FLAG    DB  ?
ROW             DB  0
FILE_END        DB  ?
FILE_HANDLE     DB  ?
LAST_PAGE       DB  ?
NOT_ENOUGH      DB  'Not enough memory$'
INVALID         DB  'Invalid directory$'
TOO_MANY        DB  'Too many files$'
LOADING         DB  'Loading and Sorting directory. ,0
LOAD_DSLT       DB  'Loading directory.',0
DIRECTORY       DB  'Directory of ',0
FILES           DB  '    files',0
DELETE_REQ      DB  ' will be deleted.',0,'Do you wish to delete it?  T/E',0
RENAME_MSG      DB  'Enter new name for ',0
MOVE_MSG        DB  'Enter new directory for ',0
DB              DB  ' DR',0
OFF             DB  'OFF',0
E0              DB  0,32,0,0

FILE_BUFFER     EQU   32767-256
SIXTEEN_K       EQU   16384

NEED  LABEL  BYTE
DB  201,20 DUP (205),187,186,' PC Magazine DE.COM ',186
DB  186,' (C) Copr. 1987 ZD  ',186,186,' Michael J. Mefford ',186
DB  188,2E DUP (186),182,186,' F1   View (or ',17,188,217,') ',186
DB  186,' F2   Delete        ',186,186,' F3   Rename       ',186
DB  186,' F6   Move          ',186,186,' F5   Confirm    DR  ',186
DB  186,' F6   WordStar ON   ',186,188,' F7   Sort by Name  ',186
DB  186,' F8   Sort by txt.  ',186,186,' F9   Sort by Size  ',188
DB  186,' F10  Sort by daTe  ',186,186,' Esc  to Exit       ',188
DB  200,20 DUP (205),188,'  Use: ',26,32,25,' PgUp PgDn  '
DB  ' "PgUp "PgDn Home End '

;-------------------------------------------------------------------------;
; Some housekeeping first. Since we will be changing the default drive    ;
; and directory to the requested drive and directory, we need to save the ;
; current defaults, so they can be restored.  If less than 640, exit.     ;
;-------------------------------------------------------------------------;

;               CODE AREA
;               ---------
BEGINNING:      MOV     AX,3301H            ;Turn Control Break off.
                MOV     DL,0
                INT     21H

                CLD                         ;String moves forward.
                MOV     AH,19               ;Get current drive.
                INT     21H
                MOV     CURRENT_DISK,AL     ;And save.

;-------------------------------------------------------------------------;
; More housekeeping. We will be writing directly to the screen buffer ;
; so we need the display card address and the status register.         ;
;-------------------------------------------------------------------------;

DISPLAY:        MOV     AX,40H              ;Point to the ROM BIOS data area
                MOV     DS,AX               ; and get base address of active
                MOV     AX,DS:[63H]         ; display card.
                ADD     AX,6                ;Add six to get status register
                PUSH    CS                  ;Done there, so restore data segment.
                POP     DS
                MOV     STATUS_REG,AX       ;Store status register.
                CMP     AH,3BAH             ;Status port of MONO card is 3BAh.
                JE      MONO                ;If that's what we got, it's MONO
                MOV     VIDEO_SEG,0B800H    ; else COLOR so add 800h.
                XOR     BH,BH               ;Get current attribute
                MOV     AH,8                ; of display page zero.
                INT     10H
                MOV     NORMAL,AH           ;Store it.
                XOR     AH,11101111B        ;Flip color bits.
                MOV     INVERSE,AH          ;Save it.
                MOV     BAR_ATTRIBUTE,AH
MONO:           XOR     BH,BH
                MOV     AH,3
                INT     10H                 ;Retrieve cursor type.
                MOV     CURSOR_TYPE,CX

                CMP     BP,65533            ;Do we have 640?
                MOV     DX,OFFSET NOT_ENOUGH
                JA      PARSE
                JMP     ERROR_EXIT          ;If no, exit.

;-----------------------------------------;
; Parse the command line for parameters. ;
;-----------------------------------------;

PARSE:          CMP     BYTE PTR DS:[80H],0 ;Any parameters?
                JNZ     GET_SWITCH          ;If yes, parse.
                JMP     MESSAGE             ;Else, skip.

GET_SWITCH:     MOV     SI,81H              ;Else, point to first character.
NEXT_SWITCH:    LODSB                       ;Get a byte.
                CMP     AL,13               ;Carriage return?
                JE      GET_PARA            ;If yes, done here.
                CMP     AL,'/'              ;Is it switch character?
                JEI     EXIT_SWITCH         ;If no, get next character.
                LODSB                       ;Get switch character.
                AND     AL,5FH              ;Capitalize.
                CMP     AL,'E'              ;If "E", sort by extension.
                JNE     CK_SIZE
                MOV     SORT_OFFSET,6
CK_SIZE:        CMP     AL,'S'              ;If "S", sort by size.
                JEI     CK_DATE
                MOV     SORT_OFFSET,8
CK_DATE:        CMP     AL,'D'              ;If "D", sort by date.
                JE      GOT_DATE
                CMP     AL,'T'              ;If "T", sort by cate.
                JEI     CK_ORIGINAL
GOT_DATE:       MOV     SORT_OFFSET,12

CK_ORIGINAL:    CMP     AL,'O'              ;If "O", don't sort at all.
                JEI     GET_PARA
                MOV     SORT_FLAG,1
GET_PARA:       MOV     SI,81H              ;Point to first character.
NEXT_PARSE:     LODSB
                CMP     AL,13               ;Carriage return or slash?
                JE      MESSAGE             ;If yes, done here.
                CMP     AL,'/'
                JE      MESSAGE
                CMP     AL,32               ;Leading space?
                JBE     NEXT_PARSE          ;If yes, get next byte.

                PUSH    SI                  ;Save start.
NEXT_PARA:      LODSB
                CMP     AL,32               ;End of parameter?
                JBE     END_PARA            ;If yes, done here.
                CMP     AL,'/'
                JE      END_PARA
                CMP     AL,':'              ;Drive request?
                JEI     NEXT_PARA           ;If no, get next byte.
                MOV     DL,BYTE PTR [SI-2]  ;Else, retrieve request.
                AND     DL,5FH              ;Capitalize.
                SUB     DL,'A'              ;Convert to DOS format.
                MOV     AH,0EH              ;And change drive.
                INT     21H
                JMP     SHORT NEXT_PARA     ;Find end of parameter.

END_PARA:       MOV     BYTE PTR DS:[SI-1],0 ;Convert parameter to ASCIIZ.
                MOV     BL,BYTE PTR DS:[SI-2]
                MOV     SI,OFFSET CURRENT_DIR ;Get current directory.
                CALL    GET_DIR
                POP     DX                  ;Retrieve start.
                DEC     DX                  ;Adjust.
                CMP     BL,':'              ;Is it a drive request?
                JE      MESSAGE             ;If yes, skip directory change.
                CMP     BL,32               ;Is it a delimiter?
                JBE     MESSAGE             ;If yes, skip.
                MOV     AH,3BH              ;Change directory.
                INT     21H
                MOV     DX,OFFSET INVALID
                JC      ERROR_EXIT          ;If error, exit.

MESSAGE:        CALL    CLS                 ;Clear screen,
                CALL    CURSOR_OFF          ;Cursor off.
                MOV     SI,OFFSET LOADING   ;Display sorting message.
                MOV     DX,0C19H
                CMP     SORT_FLAG,1         ;Unless not sorted.
                JNE     DISP_MSG
                MOV     SI,OFFSET LOAD_ONLY ;Then display loading message.
                MOV     DX,0C1FH
DISP_MSG:       CALL    DISPLAY_TEXT

                MOV     DI,OFFSET BUFFER    ;Put space character
                MOV     CX,16E0             ; in directory listing
                MOV     AX,2E20             ; buffer.
                REP     STOSW

;-------------------------------------------------------------;
; Read all the directory filenames and store me records in buffer. ;
;-------------------------------------------------------------;

READ_DIR:       MOV     DX,OFFSET STAR_DOT_STAR
                MOV     CX,7
                MOV     AH,4EH              ;Find first matching file.
                INT     21H
                JC      EXIT                ;If empty directory, exit.

STORE_NAME:     MOV     DI,OFFSET BUFFER    ;Point to buffer.
                MOV     BP,FILE_BUFFER-2E0  ;Reserve 32E for file read buffer
```

(continues)

Figure 1: *The assembly language source code for DR.COM.*

■ PROGRAMMING/UTILITIES

```
                CALL    MUPPER_NAME             ;Convert to directory format.

FIND_NEXT:      MOV     AH,4FH                  ;Find next matching.
                INT     21H
                JC      STORE_COUNT             ;If carry, no more names.
                INC     COUNT                   ;Increment count of names.
                CALL    SUPPER_NAME
                CMP     DI,BP                   ;Are we encroaching file buffer?
                JNE     FIND_NEXT               ;If no, find next.
                MOV     DX,OFFSET TOO_MANY      ;Else, exit with message.

;-------------------------------------------------------------------;
; This is the exit routine. Restore the defaults the way we found them. ;
;-------------------------------------------------------------------;

ERROR_EXIT:     MOV     AH,9                    ;Display error message.
                INT     21H
                JMP     SHORT RESET

EXIT:           CALL    CLS                     ;Clear screen.
                XOR     DX,DX                   ;Set cursor top left.
                CALL    SET_CURSOR
                CALL    CURSOR_ON               ;Turn cursor back on.
RESET:          MOV     DX,OFFSET CURRENT_DIR   ;Reset the directory.
                MOV     AH,3BH
                INT     21H
                MOV     DL,CURRENT_DRIVE        ;Reset the drive.
                MOV     AH,0EH
                INT     21H
                INT     20H

;-----------------------------------;
; Store buffer end address and page ;
; and then sort the filenames.      ;
;-----------------------------------;

STORE_COUNT:    MOV     END_OFFSET,DI           ;Store ending offset.
                ADD     DI,60
                MOV     PAGES,DI                ;Also, address for page storage.

                MOV     BX,COUNT                ;Retrieve file count.
                CMP     BX,21                   ;Enough to fill one page?
                JAE     DO_SORT                 ;If yes, use default setting.
                ADD     PAGES,800               ;Else, adjust page storage.
                MOV     AX,160                  ;Calculate last record.
                MUL     BL
                ADD     AX,323                  ;Add bar offset.
                MOV     PAGE_END,AX
DO_SORT:        CMP     SORT_FLAG,1             ;Should we sort or leave original?
                JE      READY                   ;If it was "/O", don't sort.
                CALL    SORT

;-------------------------------------------------------------------;
; Now, we are ready to get target directory and display it and the menu. ;
;-------------------------------------------------------------------;

READY:          MOV     DI,OFFSET PURGE_DIR     ;Point to storage.
                MOV     AH,19H
                INT     21H                     ;Get drive.
                ADD     AL,'A'                  ;Convert to ASCII.
                STOSB
                MOV     AL,':'                  ;Add colon.
                STOSB
                MOV     SI,DI                   ;Get directory.
                CALL    GET_DIR
                CALL    REFRESH_DIR             ;Display drive, directory, menu.

;---------------------------------------;
; We are ready for business now. We will ;
; loop here, waiting for user keystroke. ;
;---------------------------------------;

GET_KEY:        CALL    UPDATE_SCREEN
                CALL    READ_KEY                ;Get a keystroke.
                MOV     BX,AX                   ;Save returned key.
                CMP     AH,1                    ;Is it Esc or below?
                JBE     FUNCTION                ;If yes, function.
                CMP     AH,36H                  ;Is it right shift or above?
                JAE     FUNCTION                ;If yes, function.
                CMP     AH,1CH                  ;Is it CR?
                JE      FUNCTION                ;If yes, function.
                MOV     AH,2                    ;Get shift state.
                INT     16H
                TEST    AL,4                    ;Is Ctrl depressed?
                JNZ     FUNCTION                ;If no, check function request.
                CALL    NSEARCH                 ;Else, search for first letter.
                JMP     SHORT GET_KEY
FUNCTION:       MOV     DI,OFFSET DISPATCH_KEY
                MOV     AL,NN
                MOV     CX,29                   ;29 valid commands.
                REPNZ   SCASB
                JNZ     GET_KEY                         ;If no match, get another.
                MOV     DI,OFFSET DISPATCH_TABLE+56
                SHL     CX,1
                SUB     DI,CX
                CALL    DS:[DI]                 ;Else do subroutine.
                JMP     SHORT GET_KEY           ;Update screen; get next command.

                ;**************;
                ; SUBROUTINES ;
                ;**************;

;-------------------------------------------------------------------;
; These six subroutines control the bar and page of the directory listing. ;
;-------------------------------------------------------------------;

UP_ARROW:       MOV     BP,-160                 ;Move bar up one line.
                JMP     SHORT BAR_MOVE

DN_ARROW:       MOV     BP,160                  ;Move bar down one line.
BAR_MOVE:       CALL    SCROLL_BAR
                RET

PG_UP:          MOV     BP,-40*21               ;Move up 21 lines.
                CALL    SCROLL
                JMP     SHORT BOTTOM_BAR

PG_DN:          MOV     BP,40*21                ;Move down 21 lines.
MOVE_PAGE:      CALL    SCROLL

                JMP     SHORT TOP_BAR           ;Move bar to top.

HOME_BAR:       MOV     CUR_OFFSET,OFFSET BUFFER    ;Move listing to beginning.
TOP_BAR:        MOV     SI,323                      ;And move bar to top.
                CALL    MOVE_BAR
                RET

END_BAR:        MOV     AX,END_OFFSET           ;Move listing to last page.
                SUB     AX,21*40
                CMP     AX,OFFSET BUFFER
                JBE     BOTTOM_BAR
                MOV     CUR_OFFSET,AX
BOTTOM_BAR:     MOV     SI,PAGE_END             ;And move bar to bottom.
                SUB     SI,160
                CALL    MOVE_BAR
                RET

;-------------------------------------------------------------------;
; This subroutine searches for a filename with a specific first letter. ;
;-------------------------------------------------------------------;

NSEARCH:        CMP     BL,'a'                  ;Capitalize if lower case.
                JB      SEARCH_IT
                CMP     BL,'z'
                JA      SEARCH_IT
                AND     BL,5FH
SEARCH_IT:      CALL    GET_NAME                ;Get current position.
                XOR     DX,DX                   ;Zero out file counter.
                MOV     SI,SI                   ;Store current position in DI.
                MOV     SI,OFFSET BUFFER        ;Point to top of listing.
                CMP     BYTE PTR [DI],BL        ;Are we currently at a match?
                JNE     NEXT_SEARCH             ;If no, start from top.
FIND_START:     INC     DX                      ;Increment count.
                ADD     SI,40                   ;Increment record.
                CMP     SI,DI                   ;New record?
                JBE     FIND_START              ;If no, find it.

NEXT_SEARCH:    CMP     BYTE PTR [SI],BL        ;Got a match?
                JE      FOUND_IT                ;If yes, process.
INC_SEARCH:     ADD     SI,60                   ;Else, point to next record.
                ISC     DI
                CMP     BYTE PTR [SI],32        ;End of listing?
                JNE     NEXT_SEARCH             ;If no, keep searching.
                CALL    BEEP                    ;No matches, so beep.
                RET

FOUND_IT:       MOV     CX,COUNT                ;Retrieve file count.
                SUB     CX,DX                   ;Subtract search count.
                MOV     SEARCH_COUNT,CX         ;And store.
                MOV     CL,NORMAL               ;Turn off bar for now.
                MOV     BAR_ATTRIBUTE,CL
                CALL    END_BAR                 ;First move to end.
                JMP     SHORT FIND_IT
NEXT_FIND:      CALL    UP_ARROW                ;Move up to matching filename.
FIND_IT:        DEC     SEARCH_COUNT
                JNZ     NEXT_FIND
                MOV     CL,INVERSE              ;Turn bar back on and display.
                MOV     BAR_ATTRIBUTE,CL
                XCHG    BP,NP
                CALL    NSCROLL_BAR
                RET

;-------------------------------------------------------;
; This subroutine displays the highlighted file for viewing. ;
;-------------------------------------------------------;

VIEW:           CALL    GET_NAME                ;Get the file name.
                MOV     DX,OFFSET FILE_NAME     ;Open the file.
                MOV     AH,3D00H
                INT     21H
                MOV     FILE_HANDLE,AX          ;Save filehandle.

                CALL    PRINT_READ
                MOV     CALL_PAGE,OFFSET FILE_BUFFER+NINETEEN_K
                MOV     NP,PAGES                ;Initialize page pointer.
                MOV     NOW,0                   ;And row pointer.
                CALL    CLS                     ;Clear screen.

GET_VIEW:       MOV     NI,LAST_PAGE            ;Get top of current page.
                MOV     NN,NOW                  ;Get row offset into page.
                CMP     NN,0                    ;Is it row zero?
                JE      NEXT_VIEW               ;If yes, skip.
                MOV     DISPLAY_FLAG,0          ;No display.
PAGE_OFFSET:    CALL    LINES
                DEC     BH
                JNZ     PAGE_OFFSET

NEXT_VIEW:      MOV     BH,25                   ;Now display 25 lines.
                XOR     DI,DI                   ;Start at top left corner.
                MOV     DISPLAY_FLAG,1          ;Display.
VIEW_DISPLAY:   CALL    LINES
                DEC     BH
                JNZ     VIEW_DISPLAY

VIEW_COMMAND:   CALL    READ_KEY                ;Get a keystroke.
                CMP     AH,1                    ;Is it Esc?
                JE      VIEW_END                ;If yes, exit view.
                CMP     AH,1CH                  ;Is it carriage return?
                JE      VIEW_END                ;If yes, exit view.
                CMP     AH,3BH                  ;Is it F1?
                JE      VIEW_END                ;If yes, exit.
                CMP     AH,20H                  ;Is it "D"?
                JE      VIEW_DELETE             ;If yes, go to delete function.
                CMP     AH,3CH                  ;Is it F2?
                JBE     CK_RENAME               ;If no, check if rename request.
VIEW_DELETE:    CALL    VIEW_REQUEST            ;Else, close file.
                JNP     DELETE                  ;Go to delete function.
CK_RENAME:      CMP     AH,13H                  ;Is it "R"?
                JE      VIEW_RENAME             ;If yes, go to rename function.
                CMP     AH,3DH                  ;Is it F3?
                JNE     CK_MOVE                 ;If no, check if move request.
VIEW_RENAME:    CALL    VIEW_REQUEST
                JMP     RENAME
CK_MOVE:        CMP     AH,32H                  ;Is it "M"?
                JE      VIEW_MOVE               ;If yes, go to move function.
                CMP     AH,3EH                  ;Is it F4?
```

(Figure 1 continues)

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■ PROGRAMMING/UTILITIES

```
                JNZ     GET_DISPATCH            ;If no, get dispatch table.
VIEW_MOVE:      CALL    VIEW_REQUEST
                JMP     MOVF
GET_DISPATCH:   MOV     DI,OFFSET DISPATCH_KEY+2I
                MOV     AL,AX
                MOV     CX,N                    ;8 valid commands.
                REPNE   SCASB
                JNZ     VIEW_COMMAND            ;If no, match, get next stroke.
                MOV     DI,OFFSET VIEW_TABLE+14
                SHL     CX,1
                SUB     DI,CX
                CALL    DS:[DI]                 ;Do subroutine.
                JC      VIEW_COMMAND            ;Carry indicates no screen update.
                JMP     GET_VIEW                ;Else, update and get next command.

VIEW_END:       MOV     BX,FILE_HANDLE          ;Close the file.
                MOV     AH,3EH
                INT     21H
                CALL    REFRESH_DIR             ;Restore zeros.
                RET

VIEW_REQUEST:   CALL    VIEW_END                ;If request of another function,
                CALL    UPDATE_SCREEN           ; close file and update screen.
                RET

;-----------------------------------------------------------------------;
; These six subroutines control the page and starting row of the view. ;
;-----------------------------------------------------------------------;

UP_LINE:        CMP     ROW,0                   ;Are we at row zero?
                JNZ     DEC_ROW                 ;If no, decrement one row.
                CMP     HF,PAGES                ;Else, are we at first page?
                STC
                JZ      UP_LINE_END             ;If yes, no change.
                CALL    UP_PG                   ;Else, move up one page.
                MOV     ROW,25                  ;And move starting row to 25.
DEC_ROW:        DEC     ROW                     ;Decrement row.
                CLC                             ;Flag to update screen.
UP_LINE_END:    RET

DN_LINE:        CALL    CK_FILE_END             ;Are we at end of file?
                JNC     CK_ROW                  ;If no, check row.
                RET                             ;Else, return.
CK_ROW:         CMP     ROW,24                  ;Are we at last row?
                JB      INC_ROW                 ;If no, increment row.
                CALL    DN_PG                   ;Else, page down.
                MOV     ROW,-1                  ;And move row to top.
INC_ROW:        INC     ROW
                CLC
DN_LINE_END:    RET

UP_PG:          CMP     BP,PAGES                ;Are we already at first page?
                JNE     DEC_PG                  ;If so, decrement page.
                CMP     ROW,0                   ;Are we at first row?
                STC
                JZ      UP_PG_END               ;If yes, no update.
                MOV     ROW,0                   ;Else move to first row.
                JMP     SHORT UPDATE_PAGE
DEC_PG:         MOV     SI,LAST_PAGE            ;Get current page.
                SUB     SI,DS:[BP]              ;Subtract difference to prev page.
                CMP     SI,OFFSET FILE_BUFFER   ;Beyond top of buffer?
                JAE     UP_PG_RET               ;If no, page up.
                CALL    BACKWARD                ;Else, read in previous 16K
                JMP     SHORT DEC_PG            ;Try again.
UP_PG_RET:      DEC     BP
                DEC     BP                      ;Decrement page pointer.
                MOV     LAST_PAGE,SI            ;Store new starting position.
UPDATE_PAGE:    CLC
UP_PG_END:      RET

DN_PG:          CMP     BP,65535-256            ;Out of room for page storage?
                JAE     NOUPDATE_PG             ;If yes, skip.
                MOV     SI,LAST_PAGE            ;Else, retrieve current page.
                MOV     DISPLAY_PLAG,0          ;No display.
                MOV     BH,25                   ;Move up 25 lines.
NEXT_PAGE:      CALL    LINES
                DEC     BH
                JNZ     NEXT_PAGE
                CALL    CK_FILE_END             ;End of file?
                JC      NOUPDATE_PG             ;If yes, no update.
INC_PG:         MOV     DX,LAST_PAGE            ;Else, save current offset.
                MOV     LAST_PAGE,SI            ;Store new offset.
                MOV     AX,SI
                SUB     AX,DX                   ;Get difference between pages.
                INC     BP                      ;Increment page storage.
                INC     BP
                MOV     DS:[BP],AX              ;And store.
                CLC
DN_PG_END:      RET
NOUPDATE_PG:    STC
                RET

HOME_FILE:      CALL    UP_PG                   ;Page up until top of file.
                JNC     HOME_FILE
                CLC
                RET

END_FILE:       CALL    DN_PG                   ;Page down until end of file.
                JRC     END_FILE
                CLC
                RET

;-----------------------------------------------------------------------;
; This subroutine checks to see if end of file has been reached.       ;
;-----------------------------------------------------------------------;

CK_FILE_END:    CMP     SI,FILE_END
                JB      NOT_FILE_END
                CMP     FILE_END,OFFSET FILE_BUFFER+(SIXTEEN_K * 2)
                JAE     NOT_FILE_END
                STC
                RET
NOT_FILE_END:   CLC
                RET

;-----------------------------------------------------------------------;
; This subroutine formats the text into lines.  A line is marked       ;
; by either a carriage return or reaching the last column (80).        ;
;-----------------------------------------------------------------------;

LINES:          MOV     CX,80                   ;80 columns.
NEXT_LINES:     CMP     SI,FILE_END             ;If end of file, pad with spaces.
                JB      GET_LINES
                CMP     FILE_END,OFFSET FILE_BUFFER+ (SIXTEEN B * 2)
                JB      PAD_SPACES
                PUSH    BX                      ;If end of buffer, save
                PUSH    CX                      ; our pointers and
                PUSH    DI                      ; read next 16B.
                CALL    FORWARD
                POP     DI                      ;Restore pointers.
                POP     CX
                POP     BX

GET_LINES:      LODSB                           ;Get a byte.
                AND     AL,WORDSTAR_BIT         ;Strip high bit for WordStar?
                CMP     AL,13                   ;Carriage return?
                JZ      PAD_SPACES              ;If yes, pad balance of line.
                CMP     AL,9                    ;Is it tab character?
                JZ      TAB                     ;If yes, tab.
                CMP     AL,10                   ;Is it linefeed?
                JZ      NEXT_LINES              ;If yes, skip.
                PUSH    CX                      ;Save counter.
                MOV     CX,1                    ;Else, display one character.
                CALL    CH_DISPLAY
                POP     CX
NEXT_BYTES:     LOOP    NEXT_LINES              ;Get next byte.
                CMP     BYTE PTR [SI],13        ;Is this a eighty column line?
                JNZ     END_LINES               ;If no, skip.
                INC     SI                      ;Else, bump pointer past CR.
END_LINES:      RET

TAB:            PUSH    CX                      ;Save counter.
                DEC     CX                      ;Adjust column counter.
                AND     CX,7                    ;Get bottom three bits.
                INC     CX                      ;Adjust.
                PUSH    CX
                CALL    PAD_SPACES              ;Move to next tab position.
                POP     AX
                POP     CX
                SUB     CX,AX                   ;Adjust counter.
                JNZ     NEXT_LINES              ;Next byte if not column 80.
                RET

PAD_SPACES:     MOV     AL,32                   ;Space character.
CH_DISPLAY:     CMP     DISPLAY_FLAG,1          ;Are we to write it to screen?
                JNZ     CX_DISP_END             ;If no, return.
                MOV     ML,AL
WRITE_VIEW:     CALL    WRITE_SCREEN            ;Else, write CX spaces.
                LOOP    WRITE_VIEW
CX_DISP_END:    RET

;-----------------------------------------------------------------------;
; These six subroutines control the page and starting row of the view. ;
;-----------------------------------------------------------------------;

FORWARD:        SUB     LAST_PAGE,SIXTEEN B     ;Adjust current page offset.
                XOR     CX,CX                   ;Move file pointer
                MOV     DX,SIXTEEN K            ; forward 16K.
                CALL    MOVE_POINTER
FIRST_READ:     MOV     SI,OFFSET FILE_BUFFER+SIXTEEN B
                MOV     DI,OFFSET FILE_BUFFER   ;Move second half of buffer
                CALL    MOVE_BUFFER             ; to first half and read 16K.
                MOV     CX,-1                   ;Move file pointer back.
                NEG     DX
                CALL    MOVE_POINTER
                RET

BACKWARD:       ADD     LAST_PAGE,SIXTEEN F     ;Adjust current page offset.
                MOV     CX,-1                   ;Move pointer back 32K.
                MOV     DX,- (SIXTEEN E * 2)
                CALL    MOVE_POINTER
                MOV     SI,OFFSET FILE_BUFFER           ;Move first half of
                MOV     DI,OFFSET FILE_BUFFER+SIXTEEN B ; buffer to second
                CALL    MOVE_BUFFER                     ; and read 16K.
                RET

MOVE_POINTER:   MOV     BX,FILE_HANDLE
                MOV     AH,4211H                ;Move file pointer.
                INT     21H
                RET

MOVE_BUFFER:    MOV     DX,SI                   ;Save pointer.
                MOV     CX,SIXTEEN E / 2        ;Move 8K words (16B bytes).
                REP     MOVSW
                MOV     BX,FILE_HANDLE
                MOV     CX,SIXTEEN K            ;Read 16K.
                MOV     AH,3FH
                INT     21H
                MOV     SI,DX
                MOV     DX,AX
                ADD     AX,OFFSET FILE_BUFFER+SIXTEEN E
                MOV     FILE_END,AX             ;Store end of buffer offset.
                RET

;-----------------------------------------------;
; This subroutine deletes the highlighted file. ;
;-----------------------------------------------;

DELETE:         CALL    GET_NAME                ;Format the name for DOS.
                JC      DELETE_ERROR            ;If yes, skip.
                CMP     VERIFY_FLAG,0           ;Are we to warn before deleting?

                JZ      DELETE_FILE             ;If no, skip.
                MOV     SI,OFFSET FILE_NAME     ;Else, display warning message.
                MOV     DX,162DH
                CALL    DISPLAY_TEXT
                MOV     SI,OFFSET DELETE_MSG
                CALL    GET_TEXT
                MOV     DX,172DH
                CALL    DISPLAY_TEXT

QUERY:          CALL    READ_KEY                ;Get a keystroke.
                CMP     AH,31H                  ;Is it "N"?
                JZ      DELETE_END              ;If yes, exit delete.
                CMP     AX,1                    ;Is it Esc?
```

(Figure 1 continues)

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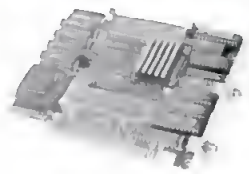

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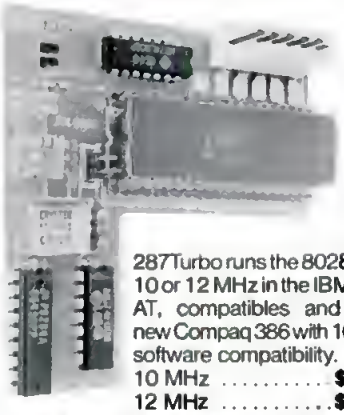

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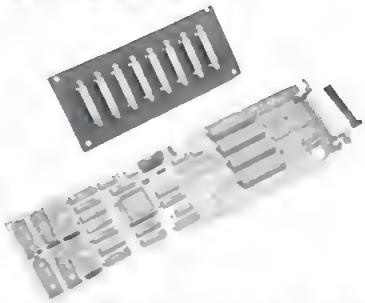

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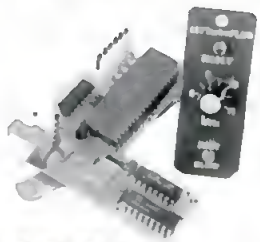

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```
                JZ      DELETE_END              ;If yes, exit delete.
                CMP     AH,15H                  ;Is it "Y"?
                JZ      DELETE_FILE             ;If yes, delete
                CALL    BEEP                    ;Else, beep.
                JMP     SHORT QUERY             ;And get another keystroke.

DELETE_FILE:    MOV     DX,OFFSET FILE_NAME     ;Delete the file.
                MOV     AH,41H
                INT     21H
                JC      DELETE_ERROR
                CALL    REMOVE_FILE             ;Remove the file from the listing.
DELETE_END:     CALL    CLEAR_MSG               ;Remove warning message.
                RET
DELETE_ERROR:   CALL    BEEP                    ;Beep if error.
                CALL    CLEAR_MSG
                RET

;-----------------------------------------;
; This subroutine renames the highlighted file. ;
;-----------------------------------------;

RENAME:         CALL    GET_NAME                ;Format name for DOS.
                JC      RENAME_ERROR
                MOV     DX,142CH                ;Display rename message.
                MOV     SI,OFFSET RENAME_MSG
                CALL    DISPLAY_TEXT
                MOV     SI,OFFSET FILE_NAME
                CALL    GET_TEXT
                MOV     DX,172CH
                CALL    CLEAR_OLD               ;Remove last entry.

NEW_NAME:       CALL    READ_KEY                ;Get a character.
                CMP     AL,27                   ;Is it Esc?
                JZ      RENAME_END              ;If yes, exit rename.
                CMP     AL,':'                  ;Ignore ":" ?" ".
                JZ      NEW_NAME
                CMP     AL,' '
                JZ      NEW_NAME
                CMP     AL,'\'
                JZ      NEW_NAME
                CMP     AL,'?'
                JZ      NEW_NAME
                CMP     AL,'*'
                JZ      NEW_NAME
                CMP     AL,13                   ;Is it carriage return?
                JZ      RENAME_IT               ;If yes, rename it.
                CMP     AL,8                    ;Is it backspace?
                JNZ     NOT_BS1
                CALL    MOVE_BS                 ;If yes, backspace.
                JMP     SHORT NEW_NAME
NOT_BS1:        CMP     AL,32                   ;Is it space or above?
                JB      NEW_NAME                ;If no, ignore.
                CMP     DI,0CH                  ;End of entry field?
                JZ      NEW_NAME                ;If yes, ignore.
                STOSB                           ;Else, store byte.
                CALL    WRITE_TEXT              ;And write it to screen.
                JMP     SHORT NEW_NAME          ;Get next keystroke.

RENAME_IT:      CALL    RENAME_FILE             ;Rename the file.
                JC      RENAME_ERROR            ;Beep if illegal.
                MOV     DX,80H                  ;Else, place new name in listing.
                MOV     CX,7
                MOV     AH,4EH
                INT     21H
                MOV     DI,CUR_FILE
                CALL    BUFFER_NAME

RENAME_END:     CALL    CURSOR_OFF              ;Turn cursor back off.
                CALL    CLEAR_MSG               ;And clear rename message.
RENAME_RET:     RET
RENAME_ERROR:   CALL    BEEP                    ;Illegal entry exit.
                CALL    CURSOR_OFF
                CALL    CLEAR_MSG
                RET

;-------------------------------------------------------------;
; This subroutine moves the highlighted file to a new directory. ;
;-------------------------------------------------------------;

MOVE:           CALL    GET_NAME                ;Format the name for DOS.
                JC      MOVE_ERROR
                MOV     DX,162BH                ;Display the move message.
                MOV     SI,OFFSET MOVE_MSG
                CALL    DISPLAY_TEXT
                MOV     SI,OFFSET FILE_NAME
                CALL    GET_TEXT
                MOV     DX,172BH
                CALL    CLEAR_OLD               ;Remove previous entry.

NEW_DIR:        CALL    READ_KEY                ;Get a keystroke.
                CMP     AL,27                   ;Is it Esc?
                JZ      MOVE_END                ;If yes, exit move.
                CMP     AL,':'                  ;Is it ":"?
                JZ      NEW_DIR                 ;If yes, skip
                CMP     AL,13                   ;Is it carriage return?
                JZ      MOVE_IT                 ;If yes, move it.
                CMP     AL,8                    ;If it backspace?
                JNZ     NOT_BS2
                CALL    MOVE_BS                 ;If yes, backspace.
                JMP     SHORT NEW_DIR
NOT_BS2:        CMP     AL,32                   ;Is it space or above?
                JB      NEW_DIR                 ;If no, ignore.
                CMP     DI,0A4H                 ;Is it at end of entry field?
                JZ      NEW_DIR                 ;If yes, ignore.
                STOSB                           ;Else, store the byte.
                CALL    WRITE_TEXT              ;And write it to screen.
                JMP     SHORT NEW_DIR           ;Get next keystroke.

MOVE_IT:        CMP     BYTE PTR DS:[80H],32    ;No entry?
                JZ      MOVE_ERROR              ;If yes, error.
                MOV     BI,OFFSET FILE_NAME     ;Point to filename.
                MOV     AL,'\'
                CMP     DS:[DI-1],AL            ;Did user add "\"?
                JZ      ADD_FILENAME            ;If yes, skip.
                STOSB                           ;Else, we have to add it.
ADD_FILENAME:   MOVSB                           ;And filename to path.
                CMP     BYTE PTR DS:[SI],0
                JNZ     ADD_FILENAME
                CALL    RENAME_FILE             ;Rename it.
                JC      MOVE_ERROR              ;Beep if illegal.
                CALL    REMOVE_FILE             ;Else remove from listing.
MOVE_END:       CALL    CURSOR_OFF              ;Cursor back off.
                CALL    CLEAR_MSG               ;Clear move message.
                RET
MOVE_ERROR:     CALL    BEEP                    ;Illegal move exit.
                CALL    CURSOR_OFF
                CALL    CLEAR_MSG
                RET

;-----------------------------------------------------------------------;
; This subroutine toggles the delete confirm and Wordstar message on and off. ;
;-----------------------------------------------------------------------;

VERIFY:         XOR     VERIFY_FLAG,1           ;Toggle flag.
                MOV     DI,OFFSET MENU+(9*22)+16 ;Point to menu.
                MOV     SI,OFFSET ON            ;Assume "ON".
                CMP     VERIFY_FLAG,1           ;Is it on?
                JZ      TOGGLE                  ;If yes, store.
                MOV     SI,OFFSET OFF           ;Else, store "OFF".
                JMP     SHORT TOGGLE

WORDSTAR:       XOR     WORDSTAR_BIT,80H        ;Toggle flag.
                MOV     DI,OFFSET MENU+(18*22)+16 ;Point to menu.
                MOV     SI,OFFSET ON            ;Assume "ON".
                CMP     WORDSTAR_BIT,7FH        ;Is it on?
                JZ      TOGGLE                  ;If yes, store.
                MOV     SI,OFFSET OFF           ;Else, store "OFF".

TOGGLE:         MOV     CX,1
                REP     MOVSB
                CALL    REFRESH_MENU            ;Display.
                RET

;-----------------------------------------------------------------------;
; These four subroutines control in which column the sorting will start. ;
;-----------------------------------------------------------------------;

SORT_NAME:      MOV     SORT_OFFSET,0
                JMP     SHORT SORT_MSG

SORT_EXT:       MOV     SORT_OFFSET,4
                JMP     SHORT SORT_MSG

SORT_SIZE:      MOV     SORT_OFFSET,8
                JMP     SHORT SORT_MSG

SORT_DATE:      MOV     SORT_OFFSET,12
SORT_MSG:       MOV     DX,1413H
                MOV     SI,OFFSET LOADING+12
                CALL    DISPLAY_TEXT

;-----------------------------------------;
; This subroutine does the actual sorting. ;
;-----------------------------------------;

SORT:           CMP     COUNT,1
                JZ      SORT_RETURN
                MOV     DX,END_OFFSET           ;End of filenames in DX.
                SUB     DX,40
                MOV     BP,SORT_OFFSET
NEXT_PASS:      MOV     SORT_FLAG,0
                MOV     BX,OFFSET BUFFER        ;Point to start of buffer.

NEXT_SORT:      MOV     SI,BX                   ;Source and destination.
                ADD     SI,SORT_TABLE[BP]
                MOV     DI,SI
                ADD     DI,40
                CMP     BP,12                   ;Is it special case of date?
                JZ      DO_DATE                 ;If yes, go do it.
                MOV     CX,SORT_TABLE[BP+2]
COMPARE:        REPE    CMPSB                   ;Compare filenames.
                JBX     END_SORT                ;If already in order, skip.

SWAP:           MOV     BI,BX                   ;Else, recover pointers.
                MOV     DI,BX
                ADD     DI,40
                MOV     CX,20                   ;Exchange the records.
NEXT_SWAP:      MOV     AX,[DI]
                MOVSW
                MOV     [SI-2],AX
                LOOP    NEXT_SWAP
                MOV     SORT_FLAG,1             ;Flag that exchange was made.

END_SORT:       ADD     BX,40                   ;Point to next record.
                CMP     BX,DX                   ;End of top?
                JB      NEXT_SORT               ;If so, bubble sort next.
                SUB     DX,40                   ;Else, move top down one record.
                CMP     SORT_FLAG,0             ;Was there exchange made?
                JNZ     NEXT_PASS               ;If yes, another pass.
SORT_RETURN:    CALL    CLEAR_MSG
                RET

DO_DATE:        MOV     CX,2                    ;Compare year first.
                REPE    CMPSB
                JA      SWAP                    ;If above, swap.
                JNZ     END_SORT
                SUB     SI,8                    ;Else, adjust end do month/day.
                SUB     DI,8
                MOV     CX,5
                REPE    CMPSB
                JA      SWAP                    ;If above, swap.
                JRZ     END_SORT
                ADD     SI,10                   ;Else, adjust end do meridien.
                ADD     DI,10
                CMPSB
                JA      SWAP                    ;If above, swap.
                JNZ     END_SORT
                SUB     SI,6                    ;Else, adjust end do time.
                SUB     DI,6
                MOV     CX,5
                CMP     WORD PTR [SI],1211H     ;Is it special case "12:"?
                JZ      CK_MERIDIAN             ;If yes, see if same.
                CMP     WORD PTR [DI],3211H     ;Is destination "12:"?
                JNZ     COMPARE                 ;If no, normal compare.
                JRF     SWAP                    ;Else, swap.
CK_MERIDIAN:    CMPSW                           ;Are both "12:"?
```

(Figure 1 continues)

```
                JNE     END_SORT                ;If no, next record.
                MOV     CH,3                    ;Else compare minutes.
                JMP     SHORT CURPARE

;---------------------------------------------------------------------;
; This subroutine gets the highlighted file and converts it to DOS format. ;
;---------------------------------------------------------------------;

GET_NAME:       MOV     SI,CUR_OFFSET           ;Get top of page.
                MOV     AX,LINE                 ;Get location of bar.
                SUB     AX,323                  ;Adjust.
                MOV     CL,2                    ;Convert to byte pointer.
                SHR     AX,CL
                ADD     SI,AX                   ;Add to current offset.
                MOV     CUR_FILE,SI             ;And save pointer.
                PUSH    SI
                MOV     DI,OFFSET FILE_NAME     ;Store the first eight characters.
                MOV     CX,8
                CALL    STORE_BYTES
                INC     SI
                CMP     BYTE PTR DS:[SI],32     ;End of name?
                JE      END_NAME                ;If yes, done here.
                MOV     AL,'.'                  ;Else, add dot.
                STOSB
                MOV     CX,3                    ;Three possible characters
                CALL    STORE_BYTES             ; in extension.
END_NAME:       MOV     BYTE PTR DS:[DI],0      ;Convert to ASCIIZ.
                POP     SI
                CMP     BYTE PTR [SI+39],'H'    ;Is it a hidden file?
                STC
                JE      NAME_ERROR              ;If yes, indicate so.
                CLC
NAME_ERROR:     RET

STORE_BYTES:    LODSB                           ;Get a character.
                CMP     AL,32                   ;If it's space, skip.
                JE      SKIP_STORE
                STOSB
SKIP_STORE:     LOOP    STORE_BYTES
                RET

;-------------------------------------------------------;
; This subroutine moves and turns the cursor on and removes ;
; the last user entry in preparation for new input.       ;
;-------------------------------------------------------;

CLEAR_OLD:      CALL    SET_CURSOR              ;Move cursor.
                CALL    CURSOR_ON               ;Turn it on.
                MOV     DI,0A0H                 ;Write spaces over old entry.
                MOV     AX,2020H
                MOV     CX,14
                REP     STOSW
                MOV     DI,0D0H                 ;Initiate pointer for entry.
                RET

;-----------------------------;
; This subroutine backspaces. ;
;-----------------------------;

MOVE_BS:        CMP     DI,0A0H                 ;At beginning of field?
                JE      MOVE_BS_END             ;If yes, skip.
                DEC     DI                      ;Else, decrement pointer.
                MOV     AX,OFFSET BA            ;Erase last character.
                CALL    GET_TEXT
MOVE_BS_END:    RET

;-------------------------------------------;
; This subroutine renames or moves the file. ;
;-------------------------------------------;

RENFILE_FILE:   MOV     BYTE PTR DS:[DI],0      ;Convert to ASCIIZ.
                MOV     DX,OFFSET FILE_NAME     ;Point to old name.
                MOV     DI,0A8H
                MOV     AH,56H                  ;Rename.
                INT     21H
                RET

;-------------------------------------------------------------------;
; This subroutine removes the filename from the directory listing. ;
;-------------------------------------------------------------------;

REMOVE_FILE:    MOV     DI,CUR_FILE             ;Point to filename.
                MOV     SI,DI                   ;Move all the records
                ADD     SI,40                   ; that follow up one.
NEXT_RECORD:    MOV     CX,28
                REP     MOVSW
                CMP     DI,END_OFFSET
                JB      NEXT_RECORD
                SUB     DI,40
                MOV     END_OFFSET,DI           ;Store new end.
                XOR     BP,BP
                CALL    SCROLL                  ;Update the screen.
                DEC     COUNT                   ;Decrement file count.
                JBZ     MORE_FILES              ;If empty, exit.
                JMP     EXIT
MORE_FILES:     CMP     COUNT,21                ;Full page?
                JAE     REMOVE_END              ;If yes, skip.
                SUB     PAGE_END,160            ;Else, adjust page end.
                MOV     BX,PAGE_END
                SUB     BX,160
                CMP     SI,LINE                 ;Is bar below directory listing?
                JA      REMOVE_END              ;If so, skip.
                CALL    MOVE_BAR                ;Else, move bar up one line.
REMOVE_END:     CALL    FILE_COUNT              ;Update file count on screen.
                RET

;-----------------------------------------;
; This subroutine displays the count of files. ;
;-----------------------------------------;

FILE_COUNT:     MOV     DI,OFFSET FILES         ;Blank out previous count.
                MOV     AX,2020H
                STOSW
                MOV     AX,COUNT
                MOV     BL,10                   ;Convert to decimal.
                STD                             ;Reverse direction.
NEXT_COUNT:     DIV     BL
                XCHG    AL,AH
                ADD     AL,'0'                  ;Convert to ASCII.
                STOSB                           ;Store the remainder.
                XCHG    AL,AH
                XOR     AH,AH
                CMP     AX,0                    ;Are we done?
                JNE     NEXT_COUNT
                CLD                             ;Back to forward direction.
                MOV     DX,1B0AH                ;Row 24; column 13.
                MOV     BX,OFFSET FILES         ;Display file count.
                CALL    DISPLAY_TEXT
                RET

;-------------------------------------------------------------------------;
; This subroutine displays the current directory, menu, and number of files. ;
;-------------------------------------------------------------------------;

REFRESH_DIR:    CALL    CLS                     ;Clear the screen.
REFRESH_MENU:   MOV     BX,OFFSET MENU          ;Point to menu position.
                MOV     DI,(2*16A)+9A           ;And to screen position.
                MOV     BH,19                   ;Display 19 lines of menu.
NEXT_REFRESH:   MOV     CH,22                   ;22 characters per line.
NEXT_MENU:      LODSB
                MOV     BL,AL
                CALL    WRITE_SCREEN
                LOOP    NEXT_MENU
                ADD     DI,116                  ;Next line.
                DEC     BH
                JNZ     NEXT_REFRESH

                MOV     DX,4
                MOV     BX,OFFSET DIRECTORY     ;Display "Directory ".
                CALL    DISPLAY_TEXT
                MOV     BX,OFFSET PARSE_DIR     ;Display working directory.
                CALL    GET_TEXT
                CALL    FILE_COUNT              ;Display file count.
                MOV     BL,INVERSE              ;Put up cursor bar.
                CALL    BAR
                RET

;-----------------------------------;
; This subroutine scrolls the screen. ;
;-----------------------------------;

SCROLL:         MOV     AX,CUR_OFFSET           ;Get current offset.
                ADD     AX,BP                   ;Add requested direction.
CK_LOWER:       CMP     SI,OFFSET BUFFER        ;If above start check upper limit.
                JAE     UPPER_LIMIT
LOWER_LIMIT:    MOV     CUR_OFFSET,OFFSET BUFFER    ;Else, make it start.
                JMP     SHORT SCROLL_RETURN         ;And update screen.

UPPER_LIMIT:    MOV     AX,END_OFFSET           ;See if beyond end of
                CMP     SI,OFFSET BUFFER+21*40  ; directory listing as well.
                JA      CK_UPPER
                MOV     CUR_OFFSET,OFFSET BUFFER
                JMP     SHORT SCROLL_RETURN

CK_UPPER:       SUB     AX,21*40
                CMP     AX,BX
                JBE     END_SCROLL
                MOV     AX,BX

END_SCROLL:     MOV     CUR_OFFSET,AX           ;Update current offset.
SCROLL_RETURN:  RET

;-------------------------------------------------;
; This subroutine scrolls the bar if between start ;
; and end of page. Otherwise the page is scrolled. ;
;-------------------------------------------------;

SCROLL_BAR:     MOV     AX,LINE                 ;Get current line.
                ADD     SI,BP                   ;Add requested line.
                MOV     BP,-40                  ;Assume below beginning.
                CMP     AX,323                  ;Is it?
                JB      SCROLL_PAGE             ;If yes, scroll page instead.
                MOV     BP,40                   ;Do the same for end of page.
                CMP     SI,PAGE_END
                JNE     SCROLL_PAGE
                CALL    MOVE_BAR
                RET

SCROLL_PAGE:    CALL    SCROLL
                RET

;-------------------------------------------------;
; This subroutine does the actual moving of the bar. ;
;-------------------------------------------------;

MOVE_BAR:       MOV     BL,NORMAL               ;Remove old bar.
                CALL    BAR
                MOV     LINE,AX                 ;And move bar to new line.
                MOV     BL,BAR_ATTRIBUTE
                CALL    BAR
                RET

BAR:            MOV     DI,LINE                 ;Retrieve line.
                MOV     CX,39                   ;Bar length 39.
NEXT_BAR:       CALL    WRITE_SCREEN            ;Write the attribute.
                LOOP    NEXT_BAR
                RET

;-----------------------------------------------;
; This subroutine displays the directory listing. ;
;-----------------------------------------------;

UPDATE_SCREEN:  XOR     BP,BP
                MOV     SI,CUR_OFFSET           ;Retrieve starting offset.
                MOV     DI,2*16A+2              ;Point to row two of screen.
                MOV     BX,21                   ;21 lines to write.
NEXT_BRITE:     MOV     CH,4A                   ;4A characters per line.
NEXT_CHAR:      LODSB                           ;Get a byte.
                MOV     BL,AL                   ;Save it in BL.
                CALL    WRITE_SCREEN            ;Write them.
                LOOP    NEXT_CHAR
                ADD     DI,AA                   ;Bump pointer to next line.
                DEC     BH                      ;Do all 21 lines.
```

(Figure 1 continues)

```
                JNZ     SEXT_WRITE
                RET

;---------------------------------------------------------------;
; This subroutine displays the directory by writing directly ;
; to the screen buffer. To avoid screen snow (snow) on the   ;
; color card, the horizontal retrace has to be monitored.    ;
;---------------------------------------------------------------;

WRITE_SCREEN:   MOV     DX,STATUS_REG           ;Retrieve status register.
                MOV     AX,VIDEO_REG            ;Point to screen segment.
                MOV     ES,AX

SCRE_RET:       IN      AL,DX                   ;Get status.
                TEST    AL,1                    ;Is it low?
                JNZ     SCRE_RET                ;If not, wait until it is.
                CLI                             ;No more interrupts.

WAIT:           IN      AL,DX                   ;Get status.
                TEST    AL,1                    ;Is it high?
                JZ      WAIT                    ;If so, wait until it is.
                MOV     AL,BL                   ;Retrieve character; now it's OK
                STOSB                           ; to write to screen buffer.
                STI                             ;Interrupts back on.
                INC     DI                      ;Bump pointer past attribute.
                PUSH    CS
                POP     ES
                RET                             ;Return

;---------------------------------------------------------------------;
; These two subroutines clear either the messages or the entire screen. ;
;---------------------------------------------------------------------;

CLEAR_MSG:      MOV     CX,1628H                ;Row 22; column 43.
                MOV     DX,174FH                ;Row 23; column 79.
                JMP     SHORT CLEAR_WINDOW

CLS:            XOR     CX,CX
                MOV     DX,184FH                ;Entire screen.
CLEAR_WINDOW:   PUSH    BP
                PUSH    BX
                MOV     BH,NORMAL               ;Clear with original attribute.
                MOV     AX,600H
                INT     10H
                POP     BX
                POP     BP
                RET

;-------------------------------------;
; These subroutines display the messages. ;
;-------------------------------------;

DISPLAY_TEXT:   CALL    RET_CURSOR              ;Move cursor.
GET_TEXT:       LODSB
                CMP     AL,0                    ;Zero marks end of string.
                JZ      END_TEXT
                CALL    WRITE_TEXT
                JMP     SHORT GET_TEXT
END_TEXT:       RET

WRITE_TEXT:     PUSH    SI                      ;BIOS does not save SI.
                MOV     AH,0EH                  ;Write teletype.
                INT     10H
                POP     SI
                RET

;---------------------------------------------------------;
; These four subroutines move the cursor, get the current ;
; directory, beep the speaker or get a keystroke.         ;
;---------------------------------------------------------;

SET_CURSOR:     PUSH    BX
                XOR     BX,BX                   ;Page zero.
                MOV     AH,2                    ;Set cursor.
                INT     10H
                POP     BX
                RET

GET_DIR:        MOV     BYTE PTR [SI],'\'       ;DOS doesn't prefece directory
                INC     SI                      ; with slash as we must.
                XOR     DL,DL
                MOV     AH,47H                  ;Retrieve default directory.
                INT     21H
                RET

BEEP:           MOV     DL,7                    ;Beep via DOS.
                MOV     AX,2
                INT     21H
                RET

READ_KEY:       MOV     AX,0                    ;Retrieve keystroke via BIOS.
                INT     16H
                RET

;-----------------------------------------------;
; These subroutines turn the cursor off and on. ;
;-----------------------------------------------;

CURSOR_OFF:     MOV     CX,2000H
                JMP     SHORT SET_TYPE

CURSOR_ON:      MOV     CX,CURSOR_TYPE

SET_TYPE:       MOV     AH,1
                INT     10H
                RET

;-------------------------------------------------;
; This long subroutine stores the filename in DIR  ;
; format. That is, filename, bytes, date and time. ;
;-------------------------------------------------;

BUFFER_NAME:    MOV     SI,158                  ;Point to filename.
                MOV     CX,12                   ;Store 12 bytes of filename.
NEXT_STORE:     LODSB                           ;Get a byte.
                CMP     AL,0                    ;End of filename?
                JZ      END_STORE               ;If yes, finish with blanks.
                CMP     AL,'.'                  ;Is it the period?
                JNZ     STORE_BYTE              ;If no, store.
                SUB     CX,3                    ;Else store 3 spaces.
                MOV     AL,32
                REP     STOSB
                ADD     CX,1
                JMP     SHORT NEXT_STORE        ;Get next byte.

STORE_BYTE:     STOSB                           ;Store byte.
                LOOP    NEXT_STORE              ;Get next byte.
END_STORE:      MOV     AL,32                   ;Pad balance with spaces.
                REP     STOSB

FILE_SIZE:      PUSH    DI                      ;Save pointer.
                ADD     DI,8                    ;Move to end of bytes field.
                MOV     DX,DS:[154]             ;Retrieve high and low words
                MOV     AX,DS:[156]             ; of bytes.
                MOV     BX,10                   ;Convert to decimal; divide by 10.
                STD                             ;Reverse direction.

NEXT_SIZE:      MOV     CX,DX                   ;Low word in CX.
                XOR     DX,DX                   ;Zero in high half.
                DIV     BX                      ;Convert to decimal.
                XCHG    AX,CX                   ;Retrieve low word.
                DIV     BX
                XCHG    AX,DX                   ;Retrieve remainder.
                ADD     AL,'0'                  ;Convert to ASCII.
                STOSB                           ;Store it.
                MOV     AX,CX                   ;Are we done?
                OR      CX,DX
                JNZ     NEXT_SIZE               ;If no, divide again.
                CLD                             ;Back to forward direction.
                POP     DI                      ;Retrieve pointer.
                ADD     DI,11                   ;Move to date field.
DATE:           MOV     DX,DS:[152]             ;Retrieve date.
                MOV     AX,DX
                MOV     CL,5                    ;Shift to lowest bits.
                ROR     AX,CL
                AND     AX,0F0                  ;Mask off all but month.
                MOV     CL,0FFH                 ;Flag as an leading zeros.
                MOV     CH,'-'                  ;Delimiting character.
                CALL    STORE_WORD              ;Store it.

                MOV     AX,DX                   ;Retrieve date.
                AND     AX,1FH                  ;Mask off all but day.
                MOV     CL,0                    ;Flag include leading zeros.
                MOV     CX,'-'
                CALL    STORE_WORD              ;Store it.

                MOV     AX,DX                   ;Retrieve date for last time.
                MOV     CL,9
                ROR     AX,CL
                AND     AX,7FH                  ;Mask off all but year.
                ADD     AX,80                   ;Adjust to ASCII.
                CMP     AX,100                  ;Past year 2000?
                JS      DISPLAY_DATE            ;If so, display. Else, adjust for
                SUB     AX,100                  ; next century. (Planning ahead!)
DISPLAY_DATE:   MOV     CL,0                    ;Display leading zeros.
                MOV     CH,12
                CALL    STORE_WORD              ;Store it.

TIME:           INC     DI                      ;Move to time field.
                MOV     DX,DS:[150]             ;Retrieve time.
                MOV     AX,DX
                MOV     CL,11                   ;Shift to hours bits.
                ROR     AX,CL
                AND     AX,1FH                  ;Mask off all but hours.
                PUSH    AX
                CMP     AX,12                   ;Past noon?
                JBE     MERIDIAN
                SUB     AX,12                   ;If yes, adjust.
MERIDIAN:       CMP     AX,0                    ;Midnight?
                JNZ     NOT_MIDNIGHT
                MOV     AX,12                   ;If yes, adjust.
NOT_MIDNIGHT:   MOV     CL,0FFH                 ;Suppress leading zeros.
                MOV     CH,':'
                CALL    STORE_WORD              ;Store it.

                MOV     AX,DX                   ;Retrieve time.
                MOV     CL,5                    ;Shift to minutes bits.
                ROR     AX,CL
                AND     AX,1FH                  ;Mask off all but minutes.
                MOV     CL,0
                POP     DX                      ;Retrieve hours.
                MOV     CH,'p'                  ;Assume PM.
                CMP     DX,12                   ;Is it PM?
                JAE     PM
                MOV     CX,'a'                  ;If no, AM.

PM:             CALL    STORE_WORD              ;Store it.
                MOV     AL,'R'
                TEST    BYTE PTR DS:[14F],6     ;Is it a hidden or system file?
                JZ      NOT_HIDDEN
                STOSB                           ;If yes, tack on an "S".
                RET
NOT_HIDDEN:     INC     DI
                RET

;---------------------------------;

STORE_WORD:     DIV     BL                      ;Divide by ten.
                ADD     AX,'00'                 ;Convert to ASCII.
                CMP     CL,0                    ;Are we to display leading zero?
                JZ      STORE_IT                ;If yes, store as is.
                CMP     AL,'0'                  ;Is it a leading zero?
                JNZ     STORE_IT                ;If no, store it.
                MOV     AL,32                   ;Else, store a space.
STORE_IT:       STOSW
                MOV     AL,CH                   ;Store delimiter character also.
                STOSB
                RET

;-------------------------------------------------;
; Approximate 700 filename buffer at end of code. ;
;-------------------------------------------------;

CURRENT_DIR     DW      0
PURGE_DIR       EQU     CURRENT_DIR+68
FILE_NAME       EQU     PURGE_DIR+66
BUFFER          EQU     FILE_NAME+11

CODE ENDS
END  START
```

(Figure 1 ends)

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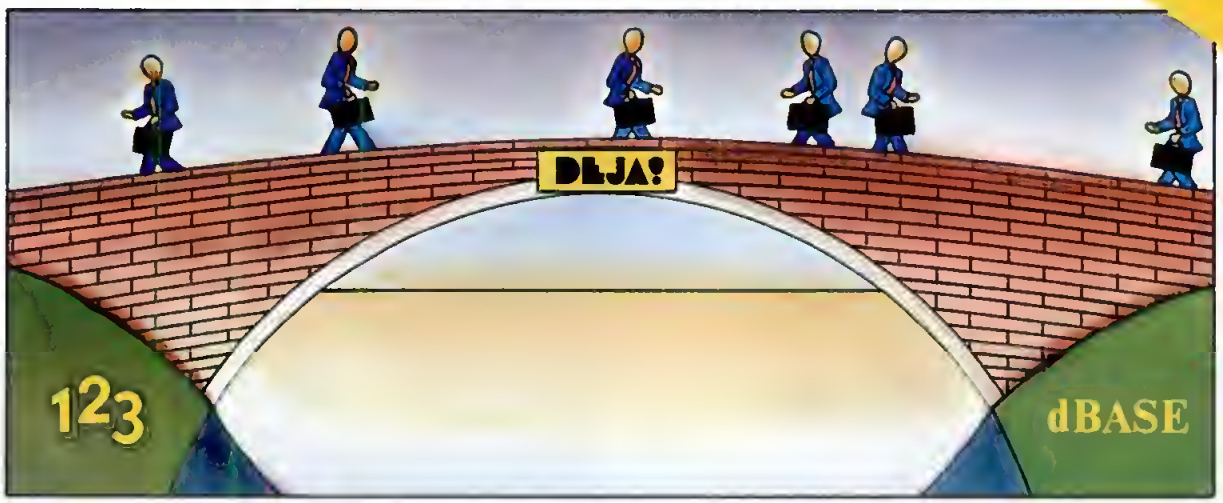

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■ PROGRAMMING/UTILITIES

```
100 REM -- BASIC PROGRAM TO CREATE DR.COM
110 OPEN "DR.COM" AS 61 LEN = 1
120 FIELD 61,1 AS A$
130 CHECKSUM = 0
140 FOR J = 1 TO  422
150    LINESUM = 0
160    FOR J = 1 TO 8
170       READ BYTE
180       CHECKSUM = CHECKSUM + BYTE
190       LINESUM = LINESUM + BYTE
200       IF (BYTE < 256) THEN LSET A$ = CHR$(BYTE)
210       PUT #3
220    NEXT J
230    READ LINECHECK
240    IF LINECHECK <> LINESUM THEN PRINT "Error in Line";200 + 10 * I
250 NEXT I
260 CLOSE
270 IF CHECKSUM = 341436 THEN PRINT "Successful Completion!" : END
280 PRINT "COM file is not valid!" : END
290 DATA    233,     41,      3,      0,      0,      0,      0,    176,    453
300 DATA      7,    112,    112,      0,      0,      0,      0,      0,    231
310 DATA      0,     12,      0,      9,      0,      3,      0,     13,     37
320 DATA      0,      0,      0,     29,      0,      0,    100,     14,    239
330 DATA      0,      0,      0,      0,      0,      0,     99,     14,    113
340 DATA      1,      0,     67,      1,     42,     46,     42,      0,    199
350 DATA      1,    127,      0,      0,      1,     17,     10,     19,    183
360 DATA     28,     28,     31,     32,     47,     49,     58,     59,    316
370 DATA     60,     61,     62,     63,     64,     65,     66,     67,    508
380 DATA     68,     71,     72,     73,     79,     80,     81,    118,    642
390 DATA    132,    105,      5,     51,     10,     89,     10,     40,    458
400 DATA      9,    105,     10,    373,      6,     97,     10,    225,    635
410 DATA      8,    173,      6,     81,     10,    169,      9,    173,    629
420 DATA      6,    225,      8,     40,      9,    169,      9,     20,    502
430 DATA     10,     51,     10,     81,     10,     89,     10,     97,    358
440 DATA     10,    105,     10,     32,      6,      4,      6,     16,    189
450 DATA      6,     45,      6,      9,      6,     24,      6,     63,    165
460 DATA      6,     38,      6,      2,      8,    184,      7,    159,    330
470 DATA      7,      9,      8,    122,      7,    207,      7,      9,    386
480 DATA      8,      2,      8,      8,      8,      8,      8,      8,     10
490 DATA      8,      8,      8,     78,    111,    116,     32,    101,    438
500 DATA    110,    111,    117,    103,    104,     32,    109,    101,    787
510 DATA    109,    111,    114,    121,     36,     73,    110,    110,    792
520 DATA     97,    100,    105,    100,     32,    100,    105,    114,    761
530 DATA    101,     99,    116,    111,    114,    121,     36,     84,    702
540 DATA    111,    111,     32,    109,     97,    110,    121,     32,    723
550 DATA    102,    105,    100,    101,    115,     36,     76,    111,    754
560 DATA     97,    100,    105,    110,    103,     32,     97,    110,    754
570 DATA    100,     32,     83,    111,    114,    116,    105,    110,    771
580 DATA    103,     32,    100,    105,    114,    101,     99,    116,    770
590 DATA    311,    114,    121,     46,      0,     76,    111,     97,    676
600 DATA    100,    105,    110,    103,     32,    100,    105,    114,    769
610 DATA    301,     99,    116,    111,    114,    121,     46,      0,    708
620 DATA     68,    105,    114,    101,     99,    116,    311,    114,    828
630 DATA    121,     32,    111,    102,     32,      0,     32,     32,    462
640 DATA     32,     32,     78,    105,    100,    101,    115,      0,    563
650 DATA     32,    119,    105,    100,    100,     32,     98,    101,    783
660 DATA     32,    100,    101,    100,    101,    116,    101,    100,    759
670 DATA     46,      0,     68,    111,     32,    121,    111,    117,    606
680 DATA     32,    119,    105,    115,    104,     32,    116,    111,    734
690 DATA     32,    100,    101,    100,    101,    116,    101,     32,    691
700 DATA    105,    116,     63,     32,     32,     89,     47,     78,    562
710 DATA      0,     69,    110,    116,    101,    114,     32,    110,    652
720 DATA    101,    119,     32,    110,     97,    109,    101,     32,    781
730 DATA    102,    111,    114,     32,      0,     69,    110,    116,    654
740 DATA    101,    114,     32,    110,    101,    119,     32,    100,    709
750 DATA    105,    114,    101,     99,    116,    111,    114,    121,    881
760 DATA     32,    102,    111,    114,     32,      0,     32,     79,    502
770 DATA     70,      0,     79,     70,     70,      0,      0,     32,    337
780 DATA      0,      0,    201,    205,    205,    205,    205,    205,   1234
790 DATA    205,    205,    205,    205,    205,    205,    205,    205,   1640
800 DATA    205,    205,    205,    205,    205,    205,    205,    107,   1622
810 DATA    106,     32,     80,     67,     32,     77,     97,    103,    674
820 DATA     97,    122,    105,    110,    101,     32,     68,     82,    717
830 DATA     46,     67,     79,     77,     32,    106,    106,     32,    705
840 DATA     48,     67,     41,     32,     67,    111,    112,    114,    584
850 DATA     46,     32,     49,     57,     56,     55,     32,     98,    417
860 DATA     68,     32,     32,    106,    106,     32,     77,    105,    718
870 DATA     99,    104,     97,    101,    100,     32,     74,     46,    661
880 DATA     32,     77,    101,    102,    102,    111,    114,    100,    739
890 DATA     32,    106,    199,    196,    196,    196,    196,    196,   1397
900 DATA    196,    196,    196,    196,    196,    196,    196,    196,   1560
910 DATA    196,    196,    196,    196,    196,    196,    196,    102,   1554
920 DATA    106,     32,     70,     49,     32,     22,     32,     86,    519
930 DATA    105,    101,    119,     32,     48,    111,    114,     32,    854
940 DATA     17,    196,    217,     41,     32,    106,    106,     32,    907
950 DATA     70,     58,     32,     32,     32,     68,    101,    108,    493
960 DATA    101,    116,    101,     32,     32,     32,     32,     32,    470
970 DATA     32,     32,     32,    106,    106,     32,     70,     51,    621
980 DATA     32,     32,     32,     82,    101,    110,     97,    109,    595
990 DATA    101,     32,     32,     32,     32,     32,     32,     32,    325
1000 DATA     32,    106,    106,     32,     70,     52,     32,     32,    622
1010 DATA     32,     77,    111,    110,    101,     32,     32,     32,    535
1020 DATA     32,     32,     32,     32,     32,     32,     32,    106,    410
1030 DATA    106,     32,     70,     53,     32,     32,     32,     67,    504
1040 DATA    111,    110,    102,    105,    114,    109,     32,     32,    715
1050 DATA     32,     79,     70,     32,     22,    106,    106,     32,    657
1060 DATA     70,     54,     32,     32,     32,     87,    111,    114,    532
1070 DATA    100,     83,    116,     97,    114,     32,     32,     79,    653
1080 DATA     70,     32,     32,    106,    106,     32,     70,     55,    671
1090 DATA     32,     32,     32,     83,    111,    114,    116,     32,    552
1100 DATA     98,    121,     32,     70,     97,    109,    101,     32,    660
1110 DATA     32,    106,    106,     32,     70,     56,     32,     32,    626
1120 DATA     32,     83,    111,    114,    116,     32,     98,    121,    787
1130 DATA     32,     69,    120,    116,     46,     32,     32,    106,    833
1140 DATA    108,     32,     78,     57,     32,     32,     32,     83,    524
1150 DATA    111,    114,    116,     32,     98,    121,     32,     83,    787
1160 DATA    105,    122,    101,     32,     32,    106,    106,     32,    796
1170 DATA     78,     49,     48,     32,     32,     83,    111,    114,    539
1180 DATA    116,     32,     98,    121,     32,    100,     97,     84,    880
1190 DATA    101,     32,     32,    106,    106,     32,     69,    115,    753
1200 DATA     99,     32,     32,    116,    111,     32,     69,    120,    611
1210 DATA    105,    116,     22,     34,     32,     32,     32,     22,    413
1220 DATA     32,    106,    200,    205,    205,    205,    205,    205,   1443
1230 DATA    205,    205,    205,    205,    205,    205,    205,    205,   1640
1240 DATA    205,    205,    205,    205,    205,    205,    205,    188,   1623
1250 DATA     32,     32,     85,    115,    101,     58,     32,     24,    479
1260 DATA     32,     25,     32,     88,    103,     85,    112,     32,    501
1270 DATA     80,    103,     68,    110,     32,     32,     32,     94,    551
1280 DATA     80,    103,     85,    112,     32,     94,     88,    103,    609
1290 DATA     68,    110,     32,     72,    111,    109,    101,     32,    635
1300 DATA     69,    110,    100,     32,    104,      1,     51,    178,    725
1310 DATA      8,    205,     32,    252,    188,     25,    205,     33,    933
1320 DATA    162,      3,      1,    184,     64,      8,    142,    216,    772
1330 DATA    161,     99,      8,      5,      6,      8,     14,     31,    316
1340 DATA    163,      4,      1,     61,    186,      3,    116,     27,    561
1350 DATA    199,      6,      6,      1,      8,    184,     58,    255,    781
1360 DATA    188,      8,    205,     16,    136,     38,      8,      1,    592
1370 DATA    128,    244,    119,    136,     38,      9,      1,    136,    811
1380 DATA     38,     10,      1,     58,    255,    188,      3,    205,    742
1390 DATA     16,    137,     14,     11,      1,    131,    252,    253,    815
1400 DATA    186,    163,      1,    119,      3,    233,    227,      8,    932
1410 DATA    128,     62,    128,      8,      8,    117,      3,    233,    671
1420 DATA    137,      8,    198,    129,      8,    172,     60,     12,    781
1430 DATA    116,     58,     60,     47,    117,    247,    172,     36,    845
1440 DATA     95,     60,     69,    117,      6,    199,      6,     13,    565
1450 DATA      1,      4,      8,     60,     83,    117,      6,    199,    470
1460 DATA      6,     13,      1,      8,      8,     60,     60,    116,    272
1470 DATA      4,     60,     84,    117,      6,    199,      6,     13,    489
1480 DATA      1,     12,      8,     60,     79,    117,      5,    198,    472
1490 DATA      6,     29,      1,      1,    198,    129,      8,    172,    520
1500 DATA     60,     13,    110,     71,     60,     47,    116,     67,    550
1510 DATA     60,     32,    110,    243,     86,    172,     60,     32,    883
1520 DATA    110,     23,     60,     47,    116,     19,     60,     58,    501
1530 DATA    117,    243,    138,     84,    254,    128,    226,     95,   1205
1540 DATA    128,    234,     65,    108,     14,    205,     33,    235,   1094
1550 DATA    220,    198,     60,    255,      8,    138,     92,    254,   1233
1560 DATA    198,     41,     14,    232,     34,      8,     98,     74,    683
1570 DATA    128,    251,     58,    116,     14,    128,    251,     32,    978
1580 DATA    110,      8,    100,     59,    205,     33,    106,    101,    971
1590 DATA      1,    114,     88,    232,    217,      7,    232,     38,    913
1600 DATA      8,    198,    214,      1,    186,     25,     12,    128,    764
1610 DATA     62,     29,      1,      1,    117,      6,    198,    245,    651
1620 DATA      1,    186,     31,     12,    232,    211,      7,    191,    871
1630 DATA    188,     14,    185,    128,     62,    184,     32,     32,    825
1640 DATA    243,    171,    186,     44,      1,    185,      7,      8,    837
1650 DATA    188,     78,    205,     33,    114,     35,    191,    188,   1824
1660 DATA     14,    189,     55,    126,    232,    246,      7,    188,   1849
1670 DATA     79,    205,     33,    114,     48,    255,      6,     48,    780
1680 DATA      1,    232,    233,      7,     59,    253,    318,    239,   3142
1690 DATA    186,    199,      1,    188,      9,    205,     33,    235,   1848
1700 DATA     11,    232,    131,      7,     51,    218,    232,    166,   1840
1710 DATA      7,    232,    200,      7,    186,     41,     34,    188,    867
1720 DATA     58,    205,     33,    138,     22,      3,      3,    188,    641
1730 DATA     14,    205,     33,    205,     32,    137,     62,     34,    722
1740 DATA      1,    131,    199,     48,    137,     62,     36,      1,    607
1750 DATA    139,     38,     48,      1,    121,    251,     21,    115,    728
1760 DATA     17,    129,      8,     36,      1,     32,      2,    184,    488
1770 DATA    160,      8,    246,    227,      5,     67,      1,    163,    869
1780 DATA     38,      1,    128,     62,     29,      1,      1,    116,    376
1790 DATA      3,    232,    196,      4,    191,    189,     14,    188,    929
1800 DATA     25,    205,     33,      4,     65,    178,    176,     58,    736
1810 DATA    170,    139,    247,    232,     98,      7,    222,     56,   1173
1820 DATA      8,    232,    225,      8,    232,     99,      7,    139,    946
1830 DATA    216,    128,    252,      1,    118,     23,    128,    252,   1118
1840 DATA     54,    115,     18,    128,    252,     28,    116,     33,    724
1850 DATA    188,      2,    205,     22,    168,      4,    117,      5,    783
1860 DATA    232,     96,      8,    235,    220,    191,     52,      1,   1027
1870 DATA    138,    199,    105,     29,      8,    242,    174,    117,   1984
1880 DATA    200,    191,    137,      1,    209,    225,     43,    249,   1263
1890 DATA    255,     21,    235,    197,    189,     96,    255,    235,   1483
1900 DATA      3,    189,    160,      8,    232,     94,      6,    195,    879
1910 DATA    109,    184,    252,    232,     34,      6,    235,     39,   1171
1920 DATA    109,     72,      2,    232,     26,      6,    235,      6,    769
1930 DATA    199,      8,     38,      1,    188,     14,    198,     67,    695
1940 DATA      1,    232,     97,      6,    195,    139,     38,     34,    734
1950 DATA      1,    129,    235,     72,      3,    129,    251,    188,   1888
1960 DATA     14,    118,      4,    137,     38,     38,      1,    139,    473
1970 DATA     54,     38,      1,    129,    230,    160,      8,    232,    852
1980 DATA     67,      6,    195,    128,    251,     97,    114,      8,    866
1990 DATA    128,    251,    122,    119,      3,    128,    227,     95,   1073
2000 DATA    232,    191,      4,     51,    218,    139,    254,    198,   1271
2010 DATA    188,     14,     56,     29,    117,      8,     66,    131,    689
2020 DATA    198,     48,     59,    247,    118,    248,     56,     28,    994
2030 DATA    116,     13,    131,    198,     48,     66,    128,     68,    752
2040 DATA     22,    117,    243,    232,    173,      8,    195,    139,   1127
2050 DATA     14,     48,      1,     43,    202,    127,     14,     58,    501
2060 DATA      3,    138,     14,      8,      1,    128,     14,     18,    322
2070 DATA      1,    232,    153,    255,    225,      3,    222,    107,   1210
2080 DATA    255,    255,     14,     58,      1,    117,    247,    130,   1077
2090 DATA     14,      9,      1,    136,     14,     18,      1,     51,    226
2100 DATA    237,    232,    193,      5,    195,    232,    106,      4,   1284
2110 DATA    106,    175,     14,    184,      8,     61,    205,     22,    850
2120 DATA    163,    159,      1,    232,    209,      1,    199,      6,    970
2130 DATA    161,      1,    255,    198,    139,     46,     36,      1,    829
2140 DATA    198,      6,    156,      1,      8,    232,     31,      6,    638
2150 DATA    139,     54,    163,      1,    338,     62,    156,      1,    712
2160 DATA    128,    255,      8,    116,     12,    198,      8,    155,    878
2170 DATA      1,      8,    232,     61,      1,    254,    207,    117,    873
2180 DATA    249,    103,     25,     51,    255,    198,      6,    155,   1122
2190 DATA      3,      1,    232,     45,      1,    254,    207,    117,    858
2200 DATA    249,    232,     54,      6,    128,    252,      1,    116,   1038
2210 DATA     84,    128,    252,     28,    116,     79,    128,    252,   1067
2220 DATA     59,    116,     74,    128,    252,     22,    116,      5,    782
2230 DATA    128,    252,     68,    117,      6,    232,     72,      8,    868
2240 DATA    233,    198,      1,    128,    252,     19,    118,      5,    952
2250 DATA    128,    252,     81,    117,      6,    232,     57,      8,    853
2260 DATA    233,      5,      2,    128,    252,     58,    118,      5,    791
2270 DATA    128,    252,     62,    117,      6,    232,     41,      8,    838
2280 DATA    233,    118,      2,    191,     73,      1,    130,    196,    944
2290 DATA    185,      8,      8,    242,    174,    117,    178,    191,   1095
```

(continues)

Figure 2: *A BASIC program that will automatically create DR.COM.*

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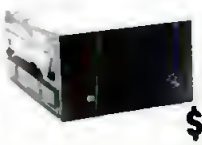

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CIRCLE 337 ON READER SERVICE CARD

AS FAST AS

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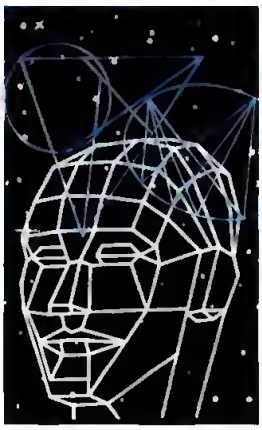

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2300 DATA  153,   1,  209,  225,   43,  249,  255,   21, 1156
2310 DATA  114,  167,  233,  123,  255,  139,   38,  159, 1228
2320 DATA    1,  108,   62,  205,   33,  232,  161,    4,  870
2330 DATA  195,  232,  241,  255,  232,   78,    5,  195, 1425
2340 DATA  128,   62,  156,    1,    8,  117,   15,   59,  530
2350 DATA   46,   36,    1,  249,  116,   13,  232,   38,  731
2360 DATA    8,  198,    6,  156,    1,   25,  254,   14,  654
2370 DATA  156,    1,  240,  195,  232,  137,    8,  115, 1084
2380 DATA    1,  195,  128,   62,  156,    1,   24,  114,  681
2390 DATA    8,  212,   59,    8,  198,    6,  156,    1,  668
2400 DATA  255,  254,    6,  156,    1,  248,  195,   59, 1174
2410 DATA   46,   36,    1,  117,   15,  128,   62,  356,  561
2420 DATA    1,    8,  249,  116,   33,  198,    6,  156,  759
2430 DATA    1,    8,  235,   25,  139,   54,  161,    1,  616
2440 DATA   62,   43,  110,    8,  129,  254,  255,  126,  987
2450 DATA  115,    5,  232,  220,    8,  235,  237,   77, 1121
2460 DATA   77,  137,   54,  161,    1,  248,  195,  129, 1082
2470 DATA  253,  255,  254,  115,   43,  139,   54,  161, 1274
2480 DATA    1,  198,    6,  155,    1,    8,  101,   25,  569
2490 DATA  232,   63,    8,  254,  207,  117,  249,  232, 1154
2500 DATA   38,    8,  114,   28,  139,   22,  161,    1,  495
2510 DATA  117,   54,  161,    1,  139,  196,   43,  194,  927
2520 DATA   69,   69,   62,  137,   78,    8,  248,  195,  858
2530 DATA  249,  195,  232,  154,  255,  115,  251,  240, 1699
2540 DATA  195,  232,  195,  255,  115,  251,  248,  195, 1686
2550 DATA   59,   54,  157,    1,  114,   18,  129,   62,  586
2560 DATA  157,    1,  255,  254,  115,    2,  249,  195, 1220
2570 DATA  248,  195,  185,   80,    8,   59,   54,  157,  970
2580 DATA    1,  114,   17,  129,   62,  157,    1,  255,  736
2590 DATA  254,  114,   61,   83,   81,   87,  232,   72,  984
2600 DATA    8,   95,   89,   91,  372,   34,    6,   49,  536
2610 DATA    1,   60,   11,  116,   43,   60,    9,  116,  418
2620 DATA   21,   60,   18,  116,  216,   81,  185,    1,  690
2630 DATA    8,  232,   30,    8,   89,  226,  206,  128,  911
2640 DATA   60,   13,  117,    1,   70,  195,   81,   73,  610
2650 DATA  129,  225,    7,    8,   65,   81,  232,    7,  744
2660 DATA    8,   88,   89,   43,  208,  117,  182,  195,  914
2670 DATA  176,   32,  128,   62,  155,    1,    1,  117,  672
2680 DATA    7,  138,  216,  232,   77,    4,  226,  251, 1151
2690 DATA  195,  129,   46,  161,    1,    8,   64,   51,  647
2700 DATA  201,  186,    8,   64,  232,   43,    8,  190,  916
2710 DATA  255,  190,  191,  255,  126,  232,   44,    8, 1293
2720 DATA  185,  255,  255,  247,  210,  232,   26,    8, 1418
2710 DATA  195,  129,    6,  161,    1,    8,   64,  185,  741
2740 DATA  255,  255,  186,    8,  128,  232,   10,    8, 1066
2750 DATA  190,  255,  126,  191,  255,  190,  232,   11, 1458
2760 DATA    8,  195,  139,   30,  159,    1,  104,    1,  709
2770 DATA   66,  205,   33,  195,  119,  214,  185,    8, 1037
2780 DATA   32,  243,  165,  139,   30,  159,    1,  185,  954
2790 DATA    8,   64,  188,   63,  205,   33,  139,  242,  926
2800 DATA  139,  208,    5,  255,  190,  163,  157,    1, 1118
2810 DATA  195,  232,   54,    2,  114,   67,  120,   62,  854
2820 DATA   48,    1,    8,  115,   44,  390,  175,   14,  588
2830 DATA  186,   85,   22,  232,   12,    4,  190,   32,  723
2840 DATA    2,  232,    9,    4,  186,   45,   23,  232,  733
2850 DATA    8,    4,  232,   45,    4,  128,  252,   40,  714
2860 DATA  116,   27,  128,  252,    1,  116,   22,  120,  790
2870 DATA  252,   21,  114,    5,  232,   28,    4,  235,  885
2880 DATA  233,  186,  175,   14,  180,   65,  205,   33, 1091
2890 DATA  114,    7,  232,  385,    2,  232,  191,    3,  886
2900 DATA  195,  232,  255,    3,  232,  184,    3,  185, 1299
2910 DATA  232,  231,    1,  114,  186,  186,   44,   22,  936
2920 DATA  190,   81,    2,  232,  196,    3,  190,  175, 1069
2930 DATA   14,  232,  193,    3,  186,   44,   23,  232,  927
2940 DATA   19,    2,  232,  229,    3,   60,   27,  116,  680
2950 DATA   71,   60,   58,  116,  245,   60,   32,  116,  758
2960 DATA  241,   60,   92,  116,  237,   60,   63,  116,  985
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2980 DATA   25,   60,    8,  117,    5,  232,    2,    2,  451
2990 DATA  235,  216,   60,   32,  114,  212,  129,  255, 1253
3000 DATA  140,    8,  116,  206,  178,  232,  144,    3, 1811
3010 DATA  235,  200,  232,  251,    1,  114,   24,  186, 1243
3020 DATA  320,    8,  185,    7,    8,  180,   70,  205,  783
3030 DATA   33,  339,   62,   32,    1,  232,  173,    3,  675
3040 DATA  232,  156,    3,  232,   73,    3,  195,  232, 1126
3050 DATA  137,    3,  232,  146,    3,  232,   63,    3,  810
3060 DATA  195,  232,  110,    1,  114,  180,  186,   43,  981
3070 DATA   22,  190,  181,    2,  232,   75,    3,  190,  815
3080 DATA  375,   14,  232,   72,    3,  186,   43,   23,  748
3090 DATA  232,  354,    1,  232,  180,    3,   60,   27,  817
3100 DATA  316,   65,   60,   58,  116,  245,   60,   13,  733
3110 DATA  116,   25,   60,    8,  117,    5,  232,  153,  716
3120 DATA    1,  235,  232,   60,   32,  114,  220,  129, 1031
3130 DATA  255,  164,    8,  116,  222,  178,  232,   39, 1190
3140 DATA    3,  235,  216,  128,   62,  120,    8,   32,  804
3150 DATA  116,   32,  190,  175,   14,  176,   92,   56,  851
3160 DATA   69,  255,  316,    1,  178,  164,  120,   60,  963
3170 DATA    8,  117,  250,  232,  122,    1,  114,   18,  846
3180 DATA  232,  131,    1,  232,   41,    3,  232,  214, 1006
3190 DATA    2,  195,  232,   22,    3,  232,   31,    3,  720
3200 DATA  232,  204,    2,  195,  128,   54,   40,    1,  864
3210 DATA    1,  191,   96,    3,  190,  126,    2,  120,  737
3220 DATA   62,   48,    1,    1,  116,   26,  190,  130,  574
3230 DATA    2,  235,   21,  128,   54,   49,    1,  120,  610
3240 DATA  391,  310,    3,  190,  126,    2,  120,   62,  820
3250 DATA   49,    1,  327,  116,    3,  190,  130,    2,  618
3260 DATA  185,    3,    8,  243,  164,  232,  180,    1, 1000
3270 DATA  195,  100,    6,   13,    1,    8,    8,  235,  649
3280 DATA   22,  199,    6,   13,    1,    4,    8,  235,  488
3290 DATA   14,  199,    6,   13,    1,    8,    8,  235,  476
3300 DATA    6,  199,    6,   13,    1,   12,    8,  186,  423
3310 DATA   51,   22,  190,  226,    1,  232,  130,    2,  862
3320 DATA  131,   62,   48,    1,    1,  116,   85,  139,  575
3330 DATA   22,   34,    1,  131,  234,   48,  139,   46,  647
3340 DATA   13,    1,  190,    6,   29,    1,    8,  187,  435
3350 DATA  180,   14,  139,  243,   62,    3,  182,   15,  846
3360 DATA    1,  139,  254,  131,  199,   48,  131,  253, 1140
3370 DATA   12,  116,   53,   62,  139,  142,   17,    1,  542
3380 DATA  243,  166,  310,   23,  139,  243,  139,  251, 1322
3390 DATA  131,  199,   48,  385,   20,    8,  139-    5,  710
3400 DATA  165,  137,   68,  254,  226,  240,  190,    6, 1382

3410 DATA   29,    1,    1,  131,  195,   48,   50,  210,  674
3420 DATA  114,  200,  131,  234,   48,  120,   62,   29,  938
3430 DATA    1,    8,  117,  182,  232,   16,    2,  195,  745
3440 DATA  185,    2,    8,  243,  166,  119,  205,  117, 1837
3450 DATA  226,  131,  210,    8,  111,  219,    8,  185, 1166
3460 DATA    5,    8,  243,  166,  119,  190,  117,  211, 1051
3470 DATA  131,  198,   18,  131,  199,   10,  166,  119,  964
3480 DATA  179,  117,  200,  131,  230,    6,  131,  239, 1241
3490 DATA    6,  165,    5,    8,  129,   60,   49,   58,  484
3500 DATA  116,    8,  129,   61,   49,   50,  117,  352,  682
3510 DATA  235,  154,  167,  117,  174,  185,    3,    8, 1035
3520 DATA  235,  142,  139,   54,   30,    1,  161,   42,  804
3530 DATA    1,   45,   67,    1,  177,    2,  211,  232,  736
3540 DATA    3,  240,  117,   54,   32,    1,   86,  191,  744
3550 DATA  175,   14,  185,    8,    8,  232,   28,    8,  642
3560 DATA   78,  128,   60,   32,  116,    9,  176,   46,  637
3570 DATA  178,  165,    1,    8,  232,   13,    8,  190,  801
3580 DATA    5,    8,   94,  128,  124,   39,   72,  249,  711
3590 DATA  116,    1,  248,  195,  172,   60,   32,  116,  948
3600 DATA    1,  178,  226,  248,  195,  232,  181,    1, 1256
3610 DATA  232,  217,    1,  191,  128,    8,  184,   32,  985
3620 DATA   32,  185,   18,    8,  243,  171,  191,  128,  968
3630 DATA    8,  195,  129,  255,  128,    8,  116,    7,  838
3640 DATA   79,  198,  134,    2,  212,  114,    1,  195,  967
3650 DATA  198,    5,    8,  186,  175,   14,  191,  128,  897
3660 DATA    8,  188,   86,  205,   33,  195,  139,   62,  980
3670 DATA   32,    1,  139,  247,  131,  198,   48,  185,  973
3680 DATA   20,    8,  243,  165,   59,   62,   14,    1,  584
3690 DATA  114,  245,  131,  239,   48,  137,   62,   34, 1082
3700 DATA    1,   51,  237,  232,  138,    8,  255,   14,  928
3710 DATA   48,    1,  117,    3,  233,  178,  249,  131,  952
3720 DATA   62,   48,    1,   21,  115,   23,  129,   46,  437
3730 DATA   38,    1,  168,    8,  139,   54,   38,    1,  431
3740 DATA  129,  238,  160,    8,   59,   54,   42,    1,  603
3750 DATA  119,    3,  232,  184,    8,  212,    1,    8,  771
3760 DATA  195,  191,   22,    2,  164,   32,   32,  171,  829
3770 DATA  161,   48,    1,  179,   18,  251,  246,  243, 1133
3780 DATA  134,  196,    4,   48,  178,  134,  196,   50,  932
3790 DATA  228,   61,    8,    8,  117,  248,  252,  186, 1804
3800 DATA   14,   24,  198,   22,    2,  232,    2,    1,  487
3810 DATA  195,  232,  215,    8,  198,  118,    2,  191, 1183
3820 DATA  162,    1,  183,   19,  165,   22,    8,  172,  744
3810 DATA  138,  216,  232,  182,    8,  226,  246,  131, 1373
3840 DATA  199,  116,  254,  207,  117,  238,  186,    4, 1321
3850 DATA    8,  198,    8,    2,  232,  219,    8,  198,  881
3860 DATA  189,   14,  232,  216,    8,  232,  169,  255, 1227
3870 DATA  138,   38,    9,    1,  232,  185,    8,  195,  710
3880 DATA  139,   54,   18,    1,    3,  245,  129,  254,  855
3890 DATA  188,   14,  115,    8,  199,    6,   38,    1,  561
3900 DATA  188,   14,  235,   32,  139,   38,   34,    1,  673
3910 DATA  129,  251,    4,   18,  119,    8,  199,    6,  734
3920 DATA   38,    1,  188,   14,  215,   14,  129,  235,  846
3930 DATA   72,    3,   59,  243,  118,    2,  139,  243,  879
3940 DATA  137,   54,   38,    1,  195,  139,   54,   42,  652
3950 DATA    1,    3,  245,  169,  216,  255,  129,  254, 1292
3960 DATA   67,    1,  114,   13,  189,   48,    8,   59,  483
3970 DATA   54,   34,    1,  115,    4,  232,    5,    8,  449
3980 DATA  195,  232,  172,  255,  195,  130,   18,    8, 1225
3990 DATA    1,  232,   12,    8,  137,   54,   42,    1,  479
4000 DATA  138,   38,   18,    1,  232,    1,    8,  195,  607
4010 DATA  139,   62,   42,    1,  185,   39,    8,  232,  700
4020 DATA   33,    8,  226,  251,  195,   51,  237,  139, 1132
4030 DATA   54,   38,    1,  191,   66,    1,  183,   21,  547
4040 DATA  185,   48,    8,  172,  136,  216,  232,   18,  993
4050 DATA    8,  226,  246,  131,  199,   88,  254,  287, 1345
4060 DATA  117,  238,  195,  139,   22,    4,    1,  161,  877
4070 DATA    6,    1,  142,  192,  236,  168,    1,  117,  863
4080 DATA  251,  250,  236,  168,    1,  116,  251,  130, 1411
4090 DATA  195,  178,  251,   71,   14,    7,  195,  185, 1088
4100 DATA   43,   22,  186,   79,   23,  235,    5,   51,  644
4110 DATA  201,  186,   79,   24,   85,   83,  130,   62,  858
4120 DATA    8,    1,  184,    8,    6,  205,   16,   91,  511
4130 DATA   93,  195,  232,   18,    8,  172,   60,    8,  770
4140 DATA  116,    5,  232,    3,    8,  235,  246,  195, 1032
4150 DATA   86,  188,   14,  205,   16,   94,  195,   86,  876
4160 DATA   50,  255,  188,    2,  205,   16,   94,  195,  997
4170 DATA  198,    4,   92,   78,   50,  210,  188,   71,  875
4180 DATA  205,   33,  195,  178,    7,  188,    2,  205, 1005
4190 DATA   33,  195,  188,    8,  205,   22,  195,  185, 1015
4200 DATA    8,   32,  235,    4,  139,   14,   11,    1,  436
4210 DATA  188,    1,  205,   16,  195,  190,  150,    8,  945
4220 DATA  185,   12,    8,  172,   60,    8,  116,   19,  564
4230 DATA   60,   46,  117,   12,  131,  233,    3,  176,  778
4240 DATA   32,  243,  178,  131,  193,    3,  235,  235, 1242
4250 DATA  178,  226,  232,  176,   32,  243,  178,   87, 1336
4260 DATA  131,  199,    8,  139,   22,  154,    8,  161,  814
4270 DATA  156,    8,  187,   18,    8,  253,  139,  202,  947
4280 DATA   51,  210,  247,  243,  145,  247,  243,  146, 1532
4290 DATA    4,   48,  178,  139,  193,   11,  202,  117,  884
4300 DATA  237,  252,   95,  131,  199,   11,  139,   22, 1886
4310 DATA  152,    8,  139,  194,  177,    5,  211,  200, 1078
4320 DATA   37,   15,    8,  177,  255,  181,   45,  232,  942
4330 DATA  114,    8,  139,  194,   37,   31,    8,  177,  692
4340 DATA    8,  181,   45,  232,  182,    8,  139,  194,  993
4350 DATA  177,    9,  231,  208,   37,  127,    8,    5,  766
4360 DATA   88,    8,   61,  100,    8,  314,    3,   45,  483
4370 DATA  188,    8,  177,    8,  181,   32,  232,   75,  797
4380 DATA    8,   71,  139,   22,  150,    8,  139,  194,  715
4390 DATA  377,   11,  211,  200,   37,   31,    8,   88,  747
4400 DATA   61,   12,    8,  118,    3,   45,   12,    8,  251
4410 DATA   61,    8,    8,  117,    3,  184,   12,    8,  377
4420 DATA  377,  255,  181,   58,  232,   37,    8,  139, 1079
4430 DATA  194,  177,    5,  211,  208,   37,   63,    8,  887
4440 DATA  177,    8,   90,  181,  112,  133,  250,   12,  953
4450 DATA  115,    2,  181,   97,  232,   13,    8,  176,  816
4460 DATA   72,  246,    6,  149,    8,    6,  116,    2,  597
4470 DATA  178,  195,   71,  195,  246,  243,    5,   48, 1173
4480 DATA   48,  128,  249,    8,  116,    6,   68,   48,  655
4490 DATA  117,    2,  176,   12,  171,  338,  197,  178, 1883
4500 DATA  195,    8,    8,    8,    8,    8,    8,    8,  195
```

(Figure 2 ends)

DOWNLOADING DR

The programs that appear in our Programming/Utilities column (as well as the other programs that we publish) can be downloaded by modem from the PC Magazine Interactive Reader Service. There is no charge for this service, but users are cautioned that these programs are copyright material and are made available only for individual, noncommercial use. You may make copies for others (including placement on noncommercial electronic bulletin boards), as long as no charge is involved. However, making copies for any commercial purpose is strictly prohibited.

The modem number for PC-IRS is (212) 696-0360. Set your modem and communications software to use 1200 (or 300) bps, 8 data bits, 1 stop bit, no parity. PC-IRS files with a .COM, .EXE, or .ARC extension require that you also use the Xmodem error-checking protocol; our other files (e.g., with extensions of .ASM or .BAS) can be downloaded using either regular ASCII or Xmodem transmission.

If you use the Xmodem protocol, you can download DR.COM directly, saving typing or downloading either the .BAS or the .ASM version. DR.BAS, whether entered from the magazine at your keyboard or downloaded from PC-IRS, will automatically create DR.COM when run once in BASIC. DR.ASM, also listed both here and on PC-IRS, allows you to modify the program but requires you to use a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM DR;
LINK DR;
EXE2BIN DR DR.COM
```

DR AT A GLANCE

DR.COM provides an integrated set of file management facilities for sorting, viewing, renaming, deleting, and moving files to another directory. The command is entered at the DOS prompt, with the following syntax:

```
DR [d:][directory]
```

The default filename display (21 per page, to a maximum of 721) is sorted alphabetically. Various switches, added to the command, may be added to sort by other criteria:

/E (sort by Extension)
/S (sort by Size)
/D or /T (sort by DaTe)
/O (sort by DOS DIR order)

Thus, for example,

```
DR \PROG /S
```

sorts the initial display of the PROG directory of the default drive by size.

When a DR listing is on-screen, a menu is displayed showing further options. A highlight bar illuminates a single filename, and the Up and Down Arrow keys move the bar a line at a time. The PgUp and PgDn keys move it a page at a time, and Ctrl-PgUp and Ctrl-PgDn move it to the top and bottom of the current page. Home and End move to the beginning and end of the directory listing. Pressing (and repeating) a letter moves the bar to the first (and successive) filename(s) beginning with that letter.

The highlighted file may be brought on-screen for viewing by pressing F1 (or Enter or Ctrl-V). The Up and Down Arrows, PgUp and PgDn, and Home and End work within the file, as well. Esc, Enter, or F1 returns you to the menu and directory listing. At the menu level, Esc terminates the program.

Within DR, these function keys or Ctrl-letter combinations are

```
F1    Ctrl-V (or Enter)          View file
F2    Ctrl-D                   Delete file
F3    Ctrl-R                   Rename file
F4    Ctrl-M                     Move file
F5    (none)        CONFIRM DELETE ON/OFF
F6    Ctrl-W       WordStar hi-bit ON/Off
F7    Ctrl-N           Sort filee by Name
F8    Ctrl-E      Sort filee by Extension
F9    Ctrl-S           Sort files by Size
F10   Ctrl-T           Sort files by Date
```

Successive sorts can be used to arrange files, e.g., in order of size and then, additionally, by extension.

Files can be renamed and may be moved from one directory to another within DR, but they cannot be copied from within DR.

mand—and you know how often you enter that. The two main advantages DR has over DIR is its speed and the ability to scroll forward as well as backward through the listing.

Finding a file from an alphabetized list is faster and easier than plowing through a DOS DIR listing. DR also comes in handy for quick perusal of .DOC and README files that often come on a new disk. Browsing through a whole directory of files may be the handiest use of DR.

DR uses an 80-column line wrap format to display files. What that means is that DR keeps displaying one line until it either encounters a carriage return or gets to the last column of an 80-column screen. DR isn't sophisticated enough to implement word wrap, nor can it guess the default margins of your word processor. Standard ASCII text files with margins of 80 columns or less will look just as you'd expect, but text files from word processors that either omit carriage returns for repaging purposes or format the text within specified margins will not display in the same format in which they were created. A word processor's page formatting control codes will appear as gibberish, of course, but this should present no major problem. The text will still be quite readable. If you chose to view an executable file, however, unless there are some embedded text strings such

■ PROGRAMMING/UTILITIES

as a copyright notice or message strings, it all will be gibberish. You might find it interesting to look for all the command strings in COMMAND.COM.

If you use DR to list the root directory of your boot disk, you will find the two DOS system files, IBMBIO.COM and IBMDOS.COM, included in the list, although they are omitted by the DOS DIR command. DR lists any hidden or system files that it finds. To distinguish these from normal files, DR places an "H" immediately after the "a" or "p" in the file creation date. If you have protected software installed on your system, you probably will find a protection scheme filename in the listing you never have seen before. These files will also be marked with the "H". You can safely FI (View) these hidden files, but if you try to delete, rename, or move them, the DR's only response will be a beep.

While debugging DR, I discovered an interesting thing about the DOS function 56H (rename or move a file). I wanted to see what would happen if I renamed IBMBIO.COM to TEST and then, after renaming some other test files, renamed TEST back to IBMBIO.COM. It seemed to work fine, but the next time I booted I got the awful DOS message, "Non-system disk or disk error." This meant that one of the three system files, IBMDOS.COM, IBMBIO.COM, or COMMAND.COM, was not found. After booting from a floppy, I discovered (with a little peeking around with DEBUG in the root directory sector of my hard disk) that IBMDOS.COM was no longer the first directory entry—which is where it belongs.

The renaming or moving process does nothing to the actual data, but it does use a new slot in the directory for the new name. You would think that DOS would use the same entry position in the directory when you rename a file, and would just write the new name right over the old name. Not so. Instead, DOS first enters the new name for the file in its next available directory space. Then DOS deletes the old name by placing the 5EH as the first character of the filename. Operation of your system and/or protected software is not only sensitive to the filename, but also to the logical location in the directory as well as its physical location (its track and sector). Therefore, for your protection, DR refuses to operate on these special files.

I should explain why the "bytes free" that complements "file(s)" with the DOS DIR command was not included in DR. There is, after all, a simple DOS interrupt function that returns this information. But DR was designed with speed in mind. Most of this speed can be attributed to DR writing directly to the screen buffer. The DOS interrupt for retrieving disk free space (function 36H) is atrociously slow. To see what I mean, at the DOS prompt

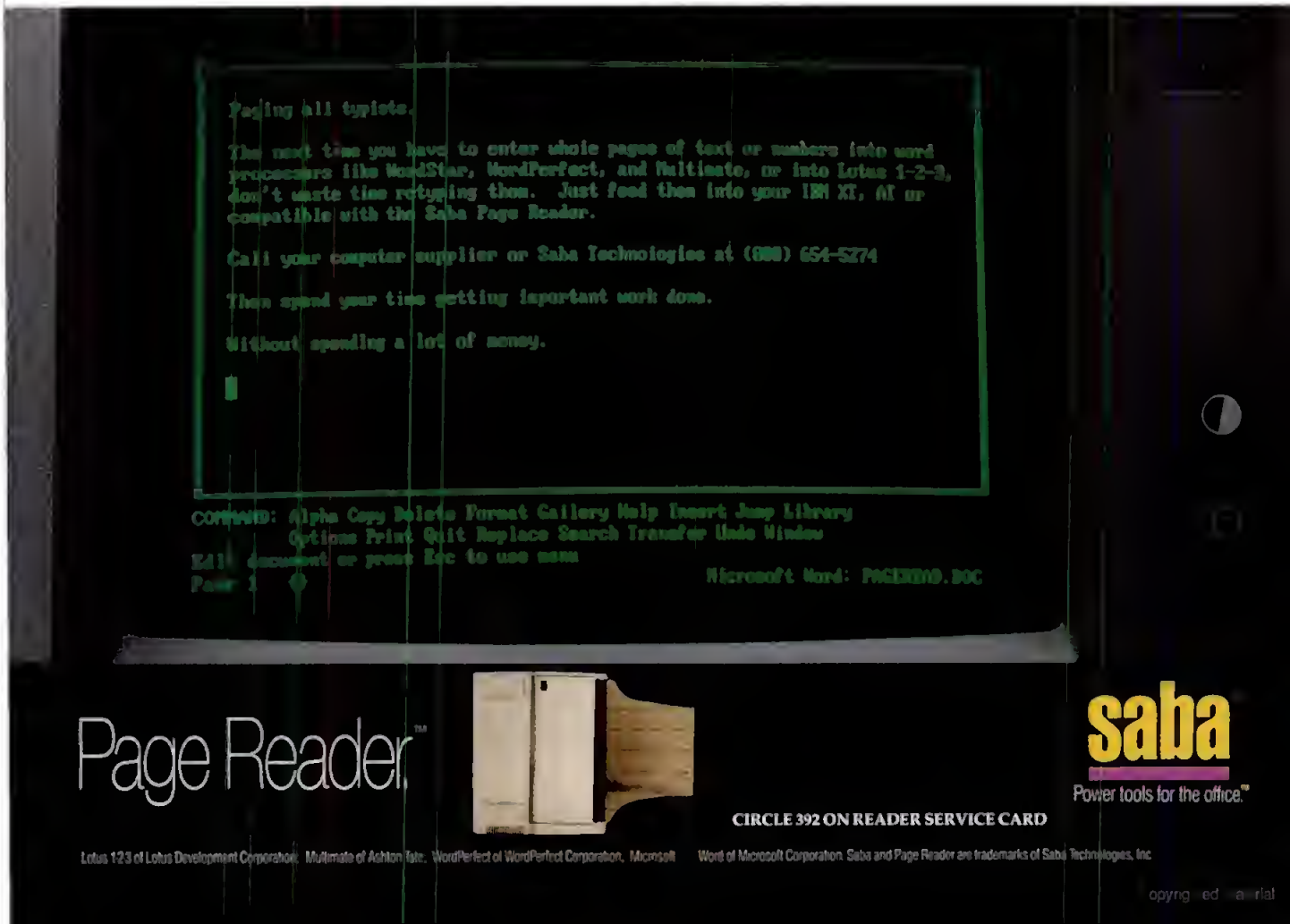
enter DIR and watch how long it takes for DOS to display "bytes free" after it whips out the file count at the end of the listing, and you'll see why the disk free space did not make it past the wish list. [*Art Merrill's FREE.COM in our Programming/Utilities column (Volume 5 Number 1) can be used to supplement DR, if desired.—Ed.*]

INSIDE DR Most of the DR code is a potpourri of somewhat modified routines I've used in other programs written for this column. The viewing function, however, presented a new, challenging subroutine. Instead of rehashing the old routines, therefore, I'll focus the discussion on DR's algorithm to display files. I'm sure I bumped into the same logic problems as Charles Petzold did when he wrote BROWSE (*PC Magazine*, Volume 5 Number 6). Both programs format the text on the fly. This is an easy task as long as the user is restricted to paging through the document in a forward direction. All the algorithm has to do is to keep a lookout for either carriage returns or linefeeds.

If backward paging is to be added, the simplest indexing algorithm is to count backward 25 linefeeds to find the previous page. (When I speak of "page" here I mean the 25 lines displayed on the standard monitor, not the 66 lines of a typewritten page.) This doesn't work so well if the line is longer than 80 columns or if carriage return/linefeed combinations are missing, as they are in the document files of many word processors, e.g., *XyWrite*. In such cases a paragraph will be strung out all on one line to the right and off the screen. And, of course, executable files will have linefeeds only by coincidence. If line wrap is employed to keep the text from exceeding the 80-column margins of the screen, then counting linefeeds can no longer be used as an indexing method to find the previous page.

I wanted DR to display the text in the 80-column format, so I added the criterion that line wrap would occur under two conditions: one, if a carriage return was encountered, or two, if column 80 was encountered before a carriage return. If column 80 is reached before a carriage return, in order to keep the text in an 80-column format, DR starts the next display on the following line. This is line wrap and should not be confused with word wrap.

The 80-column format complicates matters, however. If the user enters a request to scroll back a page, DR cannot just count backward 25 linefeeds, but instead the total number of characters displayed on the screen must be counted backward. Another problem arises in how to handle the Up and Down Arrows, requesting to move one line at a time. Let's take paging backward (moving backward 25 lines at a time) first and then I'll explain scrolling backward (moving backward a line at a time).



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It may seem as simple as storing the current offset into the file buffer for each page of the file. This works fine for small files, files under the 32K buffer DR maintains at any one time for display. When a file is first opened for viewing, 16K bytes are read into the second half of the buffer. (DR assumes that the user will find what he wants with quick peeks at the first page or so. In order to keep disk access time to a minimum, DR reads only 16K bytes at a time.)

When page forwarding reaches the end of the first 16K bytes of the file, this block is moved to the first half of the buffer and the next 16K is read into the second half of the buffer. We now have 32K bytes of the file buffered, with the current offset in the middle. Subsequent paging, forward as well as backward, will not require (for a while) another time-consuming disk read.

RELATIVE OFFSETS This shuffling of the data in the buffer has changed the address of the current offset in the buffer by 16K. Not only will the current offset be off, but all the other offsets saved with paging will also be off by 16K. In order to solve this problem, DR does not save the absolute offset of the page. Instead, it stores the relative difference between pages. This is the number of bytes it took to display one screen. In this way, all DR has to do is keep track of the current offset of the last page. You will find this variable defined as LAST_PAGE in the assembly listing. If the second half of the buffer is moved into the first half, the absolute address is adjusted by 16K and, since all the other pages are relative addresses, they are essentially adjusted as well. These page lengths are stored in a single dimensional array variable called PAGES. You can think of this as the same as the BASIC variable index function used with the dimension (DIM) statement. Thus the length of page 1 is stored in PAGE(1) and page 2 in PAGE(2), etc. With each succeeding PgUp, the current offset is adjusted by this length of page and stored as the new current offset.

LINE SCROLLING Now we come to the question of scrolling one line at a time, that is, the use of the Up and Down Arrows. Once the relative start of every page is known, scrolling by lines is easy. The row can be thought of as the second dimension of the starting offset. DR stores a variable called ROW, the current row of the current page. ROW starts out with a value of 0 pointing to row 1 of the page. (Indexing is easier when it starts at 0, as you'll see in a moment.)

Before displaying a page, DR takes the current offset, the start of the current page, and calls on the line display formatting routine (LINES) that searches for carriage returns or column 80, ROW number of times. This is the same routine that is used to display the text, so while DR finds the starting offset of the current page, a DISPLAY_FLAG is set to zero so that DR will skip writing to the screen buffer. Since ROW is initialized to zero, pointing to the first row, DR calls on the line subroutine zero times, that is, skips it entirely. Then the same line formatting routine is called upon again 25 times, this time with the DISPLAY_FLAG set to 1, to display a single page of text.

When Down Arrow is pressed, the ROW is incremented and DR calls on the LINES routine one time before displaying the text. ROW is incremented with each press of the Down Arrow. When ROW is 24 and you press the Down Arrow, indicating a request to start the display from line 26 (remember, we start the count from 0, meaning line 1), ROW is reset to zero and the page is incremented by 1 by calling on the PgDn subroutine. Just the opposite is done when Up Arrow is pressed. ROW is decremented by 1 until it reaches 0. The next scroll up request sets ROW to 24 and the page is decremented by 1. To use the BASIC DIMension notation, then, the appropriate starting display offset would be OFFSET(PAGE,ROW).

If the beginning of the buffer is reached while paging up, DR moves the current 16K bytes (the first half of the buffer) into the last half of the buffer and then reads in the previous 16K bytes of the file into the first half of the buffer. And most importantly, the current offset of the file is adjusted by adding 16K to the variable LAST_PAGE. This again places the current offset in the middle of the buffer, always giving DR plenty of elbow room to scroll forward or backward.

TYPE RIGHT DR handles one special situation that the DOS TYPE command does not. If a text file is exactly 80 columns wide, followed by a carriage return/linefeed, the TYPE command, after displaying the 80 columns of text, will wrap to the next line. The first character encountered on line 2 is the carriage return, so TYPE moves down one more line. This has the effect of double-spacing a single-spaced 80-column document. DR, after displaying column 80, checks to see if the next character is a carriage return. If so, the file pointer is bumped past it, avoiding the annoying double-spacing.

DR insists on having all 64K of the space allotted to a .COM file and, if not found, it exits with a "Not enough memory" message. The unknown string variables, current directory, request directory, and highlighted filename are all stored at the end of DR's 3370 bytes of code. This is followed by the directory listing, page lengths, and file buffer. Excluding these variables as reserved, defined bytes ex-

64K Memory Map of DR

Starting offset Hex	Decimal	
0	0	Program segment prefix (PSP) reserved by DOS
80h	128	Command line parameters. The disk transfer address (DTA).
100h	256	Single and defined variables followed by the code.
D4Dh	3405	Undefined string variables Current directory 68 bytes Requested directory 66 bytes Highlighted filename 13 bytes
DD8h	3544	Start of directory listing. Maximum of 721 filename records of 40 bytes each. • • •
7E98h	32411	Page length 50 pages minimum (100 bytes) Expands downward toward directory listing
7EFFh	32511	File buffer First half 16K
BEFFh	48895	Second half 16K (The first read is to the second half)
FEFFh	65279	Stack 256 bytes

cludes those lengthy bytes of zeros from appearing in the .COM file on disk and, most importantly, the BASIC listing (Figure 2). The file buffer has an absolute starting address 32K bytes below the 256 bytes reserved by DR for the stack, as shown in the table, "64K Memory Map of DR." The space between the string space at the end of code and the file buffer at the end of the segment is dynamically allocated for the filenames and page lengths. Just below the file buffer, DR reserves a minimum of 50 words as the storage location for the page lengths. The space between the last string variable at the end of code and the 50-word storage for pages is used for filenames. This is room enough for 721 filenames, more than enough room for most subdirectories. If, however, you hit this barrier, DR will exit with a "Too many files" message.

■ There's a constant battle between making utilities powerful and keeping their code short.

If the list of filenames is less than the 721 allocated, as will be the case with most directories, DR allocates the space from the last directory entry storage to the file buffer for the page variables, greatly increasing the number of displayable pages. This dynamic memory allocation gives DR the flexibility to meet most directory doctoring needs.

There's a constant battle between making the utilities for this column powerful and keeping their code length short, and this time the can-you-add-one-more-neat-function side won. If you enter these programs at your keyboard rather than download them from PC-IRS, I fear you'll find this one a brute. But, considering the time-saving power you're getting, I think you'll agree the work is worth it.

Michael J. Mefford is a microcomputer consultant in Oregon and a contributing editor of PC Magazine.

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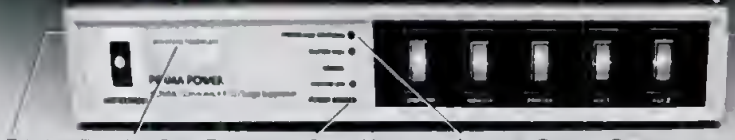

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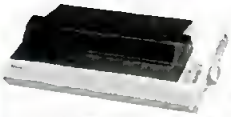

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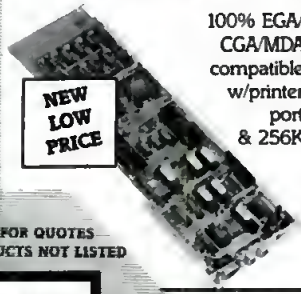

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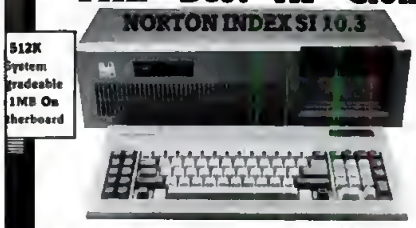

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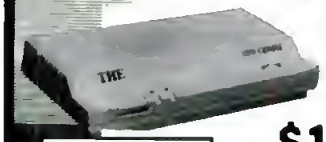

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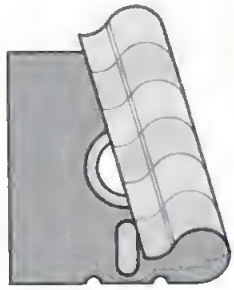

Putting extended ASCII characters in a worksheet, deleting unwanted ranges, inverting the data in columns, and eliminating unneeded translation utilities.

MANAGING EXTENDED ASCII CHARACTERS

In the past, Spreadsheet Clinic has run several methods for including extended ASCII characters in a worksheet. Once you have those extended characters in a worksheet (I simply use a short BASIC program), there are several steps you can take to make them easy to use.

Reserve a worksheet specifically for these characters and, if you're using *1-2-3*, name it ASCII.WKS. Within that worksheet, assign a range name to each character. Numbers alone won't work as range names, and a name like A255 could be interpreted as an address, so I use ZZ, followed by the ASCII number as the range name. Thus ASCII 255 has the range name ZZ255.

You can put extended characters in your current worksheet very easily if it contains the macro in Figure 1. Just put the cursor on the cell where you want the extended character and type Alt-A. Then enter the ASCII number of what you want, and it will appear in the cell. Once there, you can move or copy it, or even use the repeat prefix (\) with it.

Patrick J. Smith
Salt Lake City, Utah

```
\A      /xlEnter the ASCII number (1 - 255):  ~NUM1~
        zz
NUM1
        ~
        /c~NUM2~
        /fccn
NUM2
        ~
        ascii~
```

Figure 1: *A macro for inserting extended ASCII characters at any place in a worksheet.*

Mr. Smith's general idea for managing ASCII characters is good, but I would do some things differently. First of all, numbers do *work fine as range names, as long as you don't use them in formulas. In a worksheet like ASCII.WKS, which contains only the extended characters, I personally wouldn't bother with the ZZ prefix, but it may be better to be safe than sorry.*

Second, the macro for reading in the ASCII characters is unnecessarily elaborate. This should do the job:

```
\A    /fccn{?}~ASCII~
```

Or, if you gave the range names a ZZ prefix and would rather enter only the ASCII number when 1-2-3 *prompts you for a range, you can try*

```
\A    /fccnZZ{?}~ASCII~
```

EASY RANGE DELETION

The macro in Figure 2 makes it easy to delete range names in either *Symphony* or in Release 2.0 of *1-2-3*. All you have to do is put the cursor on the name of a range you want to eliminate and hit Alt-D.

As long as the range name \D includes both lines of the macro, you can use it to run the macro as well as to update the @cellpointer function in the second line by means of the {recalc \D} in the first line. As soon as @cellpointer is updated, the second line of the macro will display whatever label is contained in the cell you put the cursor on. In Figure 2, you would have last had the cursor on a cell that contained the label TOTAL. The /RND sequence in the first line, of course, deletes the range that has the name of whatever is displayed in the second line.

This macro can be especially handy for cleaning up a spreadsheet after you have done most of your development work. Create a table of range names and then zap the ones you no longer need. Dead range names take up valuable memory! If you have a whole series of range names to delete, you can add a third line to the macro in Figure 2 to make it an endless loop:

```
{down}{branch \D}
```

This moves the cursor down one cell and

```
\D      {recalc \D}/rnd
        TOTAL~
        Second line of macro contains
        the following formula:
        @CELLPOINTER("contents")&"~"
```

Figure 2: *A two-line macro that deletes a range name from a table of range names.*

■ SPREADSHEET CLINIC

restarts the macro so as to delete another range name. Ctrl-Break will get you out of the loop.

Mark McGilvray
Los Angeles, California

Mr. McGilvray seems to like that @cell-pointer function (see Spreadsheet Clinic in Volume 5 Number 22). And, for that matter, so do I.

INVERTING COLUMNS OF DATA

In your July 1986 Spreadsheet Clinic (Volume 5 Number 13), you printed a formula to invert a column of numbers. It used sophisticated cell and string functions but was a bit cumbersome. In Figure 3, I have written a simpler formula. It uses the @index function to reference the column to be inverted. The starting position for the inverted data is indicated by the length of the column [@count(C4..C17] and is decremented by one as you move down each row. Thus, the only difference in each formula is in the second @count function. In cell D4, the argument for the function is (D3..D3); in cell D5, it is (D3..D4), and so forth.

■ This formula to invert a column of numbers cleverly exploits the @index function rather than moving the data around by brute force.

The @iserr (@length()) at the end of the formula finds out whether the cell used to anchor the second @count function (D3) is blank. This check ensures that the formula will work as long as D3 is blank or contains a string. If it contains a value, you will get an error message at the bottom of the inverted column.

The @int(10*@rand) formula in the cells in column C simply returns a series of random numbers that will be inverted in column D. Every time you hit the Calc key, you get a new set of numbers and a new inversion.

Eric Marcus
Woodmere, New York

Yes, this is much simpler than last year's method. It cleverly exploits the power of the @index function rather than moving the data around by brute force. This method can be used to invert text as well as values, and with only a slight modification of the @index function, it can invert data in rows as well as columns. It is thus a very versatile approach.

The @iserr(@length(D3)) at the end of the formula deserves a fuller explanation. Why worry about cell D3 at all? After all, it's above the column where the inversion takes place and not part of the data. You could get rid of the whole @iserr business and forget about D3 if you used the first formula in Figure 4. Unfortunately, it's a formula for cell D4 that refers to cell D4, so even though it works fine, you get a CIRC error message.

Mr. Marcus starts the second @count function with D3 rather than D4 in order to avoid that error. Now, however, he has to worry about what's in cell D3, which explains the @iserr function. That function allows the formula to work if D3 contains a string or is blank. As he notes, however, the formula won't patch things up if D3 contains a value.

If you know that D3 will either be blank or not, you can use the shorter formulas that I have written in Figure 4. The last formula, for use when D3 is not blank, will work whether D3 contains a value or a string.

```
        C         D         E
-------------------------------
 3    RANGE1   INVERSE
 4         S         6
 5         7         9
 6         6         6
 7         4         3
 8         S         6
 9         9         6
10         1         3
11         3         1
12         6         9
13         6         5
14         3         4
15         6         6
16         9         7
17         6         S

Formula in cell D4, copied to cells DS..D17:

@INDEX($C$4..$C$17,0,@COUNT($C$4..$C$17)-@COUNT($D$3..D3)-@ISERR(@LENGTH($D$3)))

Formula in cell C4, copied to cells C5..C17:

@INT(10*@RAND)
```

Figure 3: *Formulas for inverting a column of data.*

```
Simplest formula for D4, but which gives a CIRC error:
  @INDEX($C$3..$C$16,0,@COUNT($C$3..$C$16)-@COUNT($D$4..D4))

Formula for D4 when the cell above is blank:
  @INDEX($C$3..$C$16,0,@COUNT($C$3..$C$16)-@COUNT($D$3..D3)-1)

Formula for D4 when the cell above is not blank:
  @INDEX($C$4..$C$17,0,@COUNT($C$4..$C$17)-@COUNT($D$3..D3))
```

Figure 4: *Alternative formulas for cell D4.*

TOO MANY TRANSLATORS

The translation utilities of *1-2-3* and *Symphony* provide a good way to exchange data between different programs. However, if you have those utilities on a hard disk, you can save space by getting rid of the ones you're not likely to use. Figure 5 is a list of *1-2-3*, Release 2.0, translation files and what they do. If, for example,

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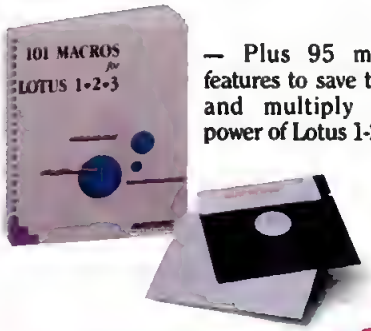

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■ SPREADSHEET CLINIC

■ If you have the translation utilities of *1-2-3* or *Symphony* on a hard disk, you can save space by getting rid of the ones you're not likely to use.

you never translate *dBASE* files to *1-2-3* format, you can get rid of DBF2.XLT and DBF3.XLT and never miss them.

What's more, the translation engine itself can tell which files are on the disk and which are not. It will display as menu options only those translations for which the utility files remain on the disk.

Dan Domzalski
Buffalo Grove, Illinois

Getting rid of the dBASE *utilities alone will save more than 75K bytes of disk space. Get rid of them all, and you'll win back more than 184K.*

```
File Name                    Function
-------------------------------------------------------------
TRANS.COM          - Translation Engine.
DIF.XLT            - DIF files to Lotus format.
DBF2.XLT           - dBase II to Lotus format.
DBF3.XLT           - dBase III to Lotus format.
JZZLOTUS.XLT       - Jazz to Lotus format.
VCWRK.XLT          - VisiCalc to Lotus format.
WR1WRK.XLT         - Symphony (1.1) & 123 (2.0) to Symphony (1.0).
WRKWR1.XLT         - 123 (1A) to Symphony/123 (2.0).
WR1WKS.XLT         - Symphony (1.1) & 123 (2.0) to 123 (1A).
```

Figure 5: *The* 1-2-3 *translation files and their functions.*

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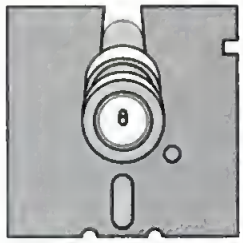
CIRCLE 314 ON READER SERVICE CARD

■ FRANK J. DERFLER, JR.

CONNECTIVITY CLINIC



Two free programs, SRVCLOCK and NETCLOCK, transfer time and date information from the server to the workstations on the IBM Token-Ring Network and others.

LAN GETS THE TIME OF DAY

After installing our IBM Token-Ring Network, we found we needed to get the date and time from one of the servers and transfer it to any of the network nodes. Most of the workstations on our network are IBM PC-XTs without a real-time clock. Getting the time and date from the server saves us from having to buy clock boards for every workstation. IBM supplies the information necessary to write network applications in the IBM PC Network Technical Reference manual and in the IBM PC Local Area Network manual.

Together, the programs SRVCLOCK.ASM and NETCLOCK.ASM transfer the time to the workstations. SRVCLOCK, a RAM-resident program, furnishes time and date information. It can run on any network node, although running it on a dedicated, continuously powered network server makes more sense. Since DOS isn't reentrant, it is necessary to read the CMOS RAM directly; hence this routine will only work on AT-type machines.

NETCLOCK is the calling program. It uses the machine name (always unique) and calls SRVCLOCK. SRVCLOCK responds by sending the date and time to NETCLOCK. NETCLOCK then installs the date and time in the node using DOS interrupts 2BH and 2DH.

The programs have been tested on the IBM Token-Ring Network; they should function correctly on the IBM PC Network and maybe other networks using NETBIOS.

Alan Queen
Boise, Idaho

We tested these two programs in a system using the IBM PC Network (Sytek) networking cards, and both of them worked just fine. We have tried it only on IBM PC AT servers.

Mr. Queen's programs are an excellent example of how NETBIOS establishes a session between stations across the network. In the section of SRVCLOCK documented as NETBIOS ADD NAME CALL, the program generates a 5C hex interrupt to call NETBIOS. This call directly addresses the IBM network adapter card. In the preceding section, the ES:BX register pair is set to the address of an important part of NETBIOS called the Network Control Block (NCB).

The NCB gives NETBIOS certain data elements in a specific format. The last section of both programs sets up this NCB. Note that the program sets all fields to binary zero at the beginning. These fill characters are part of the NCB format. The buffers must be specified for the corresponding NCB fields, and each outstanding NCB command needs a minimum stack space of 20 bytes.

■ Most workstations on our network are XTs. Getting the time and date from the server saves us from having to buy them clock boards.

Command 14H transmits the data at the address specified in BUFFER@. The BUF_LENGTH statement sets the size of the buffer to be transmitted. The POST field tells NETBIOS the address of the routine to be executed after a command process is completed. Command 12H is used later to "hang up" on the session.

In the NETCLOCK program, the line

```
ADAPTER_STAT        MOV     COMMAND,33H
```

initiates a sequence that gets status information from the local network adapter card and lets NETBIOS know its own address.

The CALL sequence in the NETCLOCK program

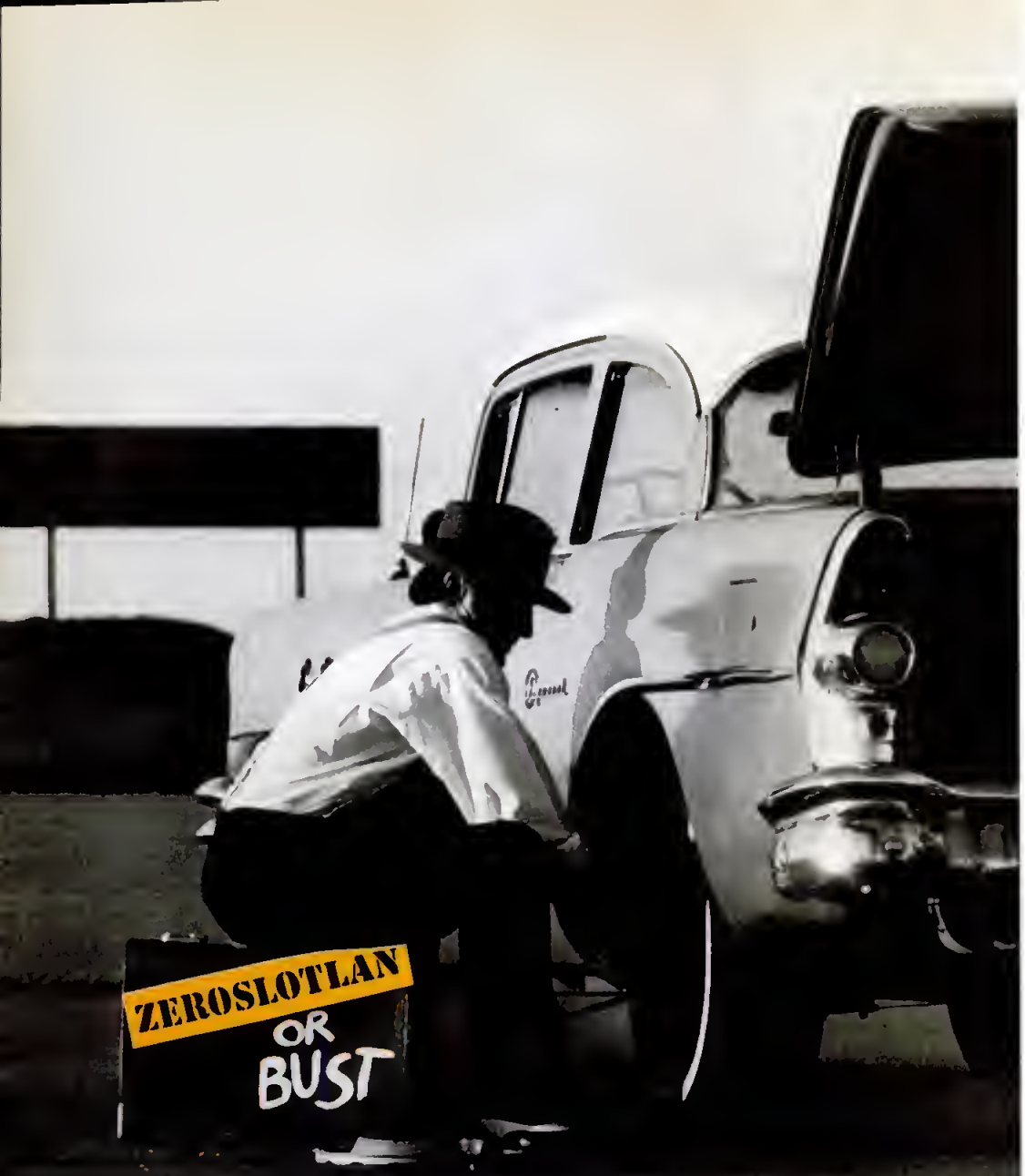
```
CALL:           MOV     COMMAND,10H
                MOV     BX,OFFSET MCB
                INT     5CH
                CMP     AL,00H
                JE      GET_TIME
```

works with the LISTEN sequence in the SRVCLOCK program

```
LISTEN:         MOV     COMMAND,91H
                MOV     POST@,OFFSET GET_CLOCK
                MOV     POST@+2,CS
                MOV     BX,OFFSET MCB
                INT     5CH
```

to exchange the time across the network.

NETBIOS is used in the same way by many networked applications programs to send electronic mail and especially to fa-



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CIRCLE 191 ON READER SERVICE CARD

■ CONNECTIVITY CLINIC

```
                                SRVCLOCK.ASM

; A background task for use on any AT running netbios.  This routine will
; get and send its date and time information to a any node executing
; NETCLOCK.EXE.  NETCLOCK.EXE then installs the received date and time in the
; node.  Since SRVCLOCK.EXE reads the AT's CMOS RAM chip directly, it works
; only on ATs.


CR              EQU     0DH
LF              EQU     0AH

CSEG    SEGMENT PARA    PUBLIC  'CODE'
NET             PROC    FAR
                ASSUME  CS:CSEG,DS:NETDATA,SS:STACK,ES:NETDATA
                PUSH    DS
                XOR     AX,AX
                PUSH    AX
                MOV     AX,NETDATA
                MOV     DS,AX
                MOV     ES,AX
;
;deallocate block containing environment
;
                MOV     AH,62H                  ;get program segment prefix
                INT     21H                     ;address
                PUSH    DS                      ;save old data segment
                MOV     DS,BX                   ;mov PSP segment to DS
                MOV     ES,DS:[2CH]             ;move the block address
                MOV     AH,49H                  ;containing the environment
                INT     21H                     ;and deallocate it
                POP     DS                      ;restore DS
                MOV     AX,DS                   ;
                MOV     ES,AX                   ;and ES
;
;netbios add name call (waits for completion)
;
ADD_NAME:       MOV     COMMAND,30H             ;Command 30H adds a name
                MOV     BX,OFFSET MCB           ;point BX at MCB
                INT     5CH                     ;call netbios
                CMP     RETCODE,00H             ;check for success
                JE      PREP_REC                ;prepare for TSR if good
                MOV     DX,OFFSET ADD_ERR       ;else write error message
                JMP     ERROR                   ;name that was not successful
PREP_RES:
                MOV     DX,30H                  ;number of paragraphs for
                                                ;terminate and stay resident
;
; do netbios listen posting into get clock, then terminate and stay resident
;
                MOV     COMMAND,91H             ;Move listen to MCB no wait
                MOV     POST@,OFFSET GET_CLOCK  ;and post at get clock
                MOV     POST@+2,CS              ;routine
                MOV     BX,OFFSET MCB           ;point BX to MCB
                INT     5CH                     ;netbios call
                CMP     AL,00h                  ;check for good return
                JE      GO_RES                  ;if good make resident
                MOV     DX,OFFSET LSN_ERR       ;else write error
                JMP     ERROR                   ;
GO_RES:         MOV     AH,31H                  ;DOS terminate and stay
                INT     21H                     ;resident
;
;this listen is returned to after a post into GET_CLOCK
;
LISTEN:         MOV     COMMAND,01H             ;Move listen to MCB
                MOV     POST@,OFFSET GET_CLOCK  ;also posts to clock
                MOV     POST@+2,CS              ;routine
                MOV     BX,OFFSET MCB           ;point BX to block
                INT     5CH                     ;netbios call
                STI                             ;restore interrupts
                IRET                            ;and return
;
; get date and time to send to requesting node
;
GET_CLOCK:      CLI                             ;cut off interrupts
                MOV     AX,ES                   ;ES is restored by network
                MOV     DS,AX                   ;use to restore DS
                XOR     AX,AX                   ;clear AX
                MOV     AL,09                   ;09 = Year
                OUT     70H,AL                  ;Read time clock at 70H
                IN      AL,71H                  ;returns at 71H
                CALL    BCD2BIN                 ;convert to binary
                ADD     AX,7CCH                 ;add 1900 decimal, only works
                                                ;until 1999
                MOV     YEAR,AX                 ;load buffer with year

                XOR     AX,AX
                MOV     AL,08                   ;get month
                OUT     70H,AL                  ;
                IN      AL,71H                  ;
                CALL    BCD2BIN                 ;
                MOV     MONTH,AL                ;

                XOR     AX,AX                   ;
                MOV     AL,07                   ;get date of month
                OUT     70H,AL                  ;
                IN      AL,71H                  ;
                CALL    BCD2BIN                 ;
                MOV     DAY,AL                  ;

                XOR     AX,AX                   ;
                MOV     AL,04                   ;get hours
                OUT     70H,AL                  ;
                IN      AL,71H                  ;
                CALL    BCD2BIN                 ;
                MOV     HOURE,AL                ;

                XOR     AX,AX
                MOV     AL,02                   ;get minutes
                OUT     70H,AL                  ;
                IN      AL,71H                  ;
                CALL    BCD2BIN                 ;
                MOV     MINUTES,AL              ;
                XOR     AX,AX                   ;
                MOV     AL,00                   ;get seconds
                OUT     70H,AL                  ;
                IN      AL,71H                  ;
                CALL    BCD2BIN                 ;
                MOV     SECONDS,AL              ;
;
; send clock data to requesting node using a netbios send
;
                MOV     BUFFER@,OFFSET CLOCK    ;point to clock data area
                MOV     BUFFER@+2,DS            ;insure correct segment
                MOV     BUF_LENGTH,8            ;clock takes 8 bytes
                MOV     COMMAND,14H             ;14H=send and wait
                MOV     BX,OFFSET MCB           ;point to MCB
                INT     5CH                     ;netbios
                                                ;
HANGUP:         MOV     COMMAND,12H             ;12H=hangup
                MOV     BX,OFFSET MCB           ;point BX
                INT     5CH                     ;netbios call
                                                ;
                MOV     BL,OFFSET FILL_NAME     ;fill name=listen any
                MOV     DI,OFFSET CALLNAME      ;move to call name
                MOV     CX,0FH                  ;names are 16 bytes
                REPNZ   MOVSB                   ;
                JMP     LISTEN                  ;back to waiting for a call

;
;error message, failed before becoming resident
;
ERROR:          MOV     AH,09H                  ;display error message
                INT     21H                     ;if routine fails before
                                                ;becoming resident
                MOV     COMMAND,12H             ;hang up session if any
                MOV     BX,OFFSET MCB           ;point BX
                INT     5CH                     ;netbious call
EXIT:           RET

NET             ENDP

;
;procedure to convert time as delivered from CMOS clock (binary coded decimal)
;to binary (as used by DOS function calls and NETCLOCK.EXE) (returns in AL)
;
BCD2BIN         PROC    NEAR
                PUSH    AX                      ;save contents
                AND     AL,0F0H                 ;clear out low nibble
                SHR     AL,1                    ;divide by 16
                SHR     AL,1                    ;so that hi nibble is
                SHR     AL,1                    ;now in lo position
                SHR     AL,1                    ;
                MOV     BL,AL                   ;hold in BL
                SHL     AL,1                    ;multiply by ten, two here
                SHL     AL,1                    ;four
                SHL     AL,1                    ;eight
                ADD     AL,BL                   ;nine
                ADD     AL,BL                   ;ten
                POP     BX                      ;get previous AX contents
                AND     BL,0FH                  ;clear out hi nibble
                ADD     AL,BL                   ;add to total
                RET
BCD2BIN         ENDP


CSEG            ENDS
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                       message data
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
NETDATA SEGMENT PARA PUBLIC 'DATA'
ADD_ERR         DB      CR,LF,'"ADD NAME" COMMAND FAILED',CR,LF,'$'
LSN_ERR         DB      CR,LF,'"LISTEN" COMMAND FAILED',CR,LF,'$'
FILL_NAME       DB      '*               '
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                       clock data area
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
CLOCK           EQU     $
YEAR            DW      0000H
MONTH           DB      00H
DAY             DB      00H
HOURE           DB      00H
MINUTES         DB      00H
SECONDS         DB      00H
HUNDREDTHS      DB      00H
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;                       message control block
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
MCB             EQU     $
COMMAND         DB      00H
RETCODE         DB      00H
LSN             DB      00H
NUM             DB      00H
BUFFER@         DW      0000H
                DW      0000H
BUF_LENGTH      DW      0000H
CALLNAME        DB      '*               '
OUR_NAME        DB      'SRV CLOCK       '
RTO             DB      00H
STO             DB      00H
POST@           DW      0000H
                DW      0000
ADAPTER_NUM     DB      00H
CMD_STAT        DB      00H
RESERVE         DB      14 DUP(0)

NETDATA         ENDS

STACK           SEGMENT PARA STACK 'STACK'
                DB      32 DUP('STACK   ')
STACK           ENDS

                END
```

The assembly language listing for SRVCLOCK.

■ CONNECTIVITY CLINIC

```
                NETCLOCK

; Netclock runs on the IBM PCLAN and PCNP programs and obtains the time and
; date from a network server running SRVCLOCK.EXE or SRVCLGRP.EXE.  Netclock
; must be executed in a workstation after the "net start" command.

CR              EQU     0DH
LF              EQU     0AH

CSEG    SEGMENT PARA    PUBLIC  'CODE'
NET             PROC    FAR
                ASSUME CS:CSEG,DS:NETDATA,SS:STACK,ES:NETDATA
                PUSH    DS
                XOR     AX,AX
                PUSH    AX
                MOV     AX,NETDATA
                MOV     DS,AX
                MOV     ES,AX
                MOV     CX,00H
;
;do netbios adapter status to obtain machine name (wait for completion)
;
ADAPTER_STAT:   MOV     COMMAND,33H             ;Command 33=adapter status
                MOV     BUFFER0+2,DS            ;high word buffer=data segment
                MOV     AX,OFFSET RETP          ;move offset of
                MOV     BUFFER0,AX              ;return area into NCB buffer
                MOV     BUF_LENGTH,60           ;minimum possible space=60
                MOV     BX,OFFSET NCB           ;point BX to NCB
                INT     5CH                     ;call to netbios
                CMP     RETCODE,0               ;return code should be 0
                                                ;error of buffer to small(06)
                JE      GET_NAME                ;get machine name returned
                MOV     DX,OFFSET STAT_ERR      ;else status error message
                JMP     ERROR                   ;
GET_NAME:       MOV     SI,OFFSET RETP          ;move machine name to position
                MOV     DI,OFFSET DUP_NAME+10   ;after 10 bytes of 00h
                MOV     CX,6                    ;6 bytes = machine name
        REPNE   MOVSB                           ;
;
;change callname to SRV_CLOCK
;
                MOV     SI,OFFSET SERVER_NAME   ;Move server name
                MOV     DI,OFFSET CALLNAME      ;into NCB
                MOV     CX,16                   ;use all 16 bytes
        REPNE   MOVSB                           ;
;
;do netbios call (wait for completion)
;
CALL:           MOV     COMMAND,10H             ;Move call command code to NCB
                MOV     BX,OFFSET NCB           ;point BX at NCB
                INT     5CH                     ;call netbios
                CMP     AL,00H                  ;check completion code
                JE      GET_TIME                ;if ok, receive server time
                MOV     DX,OFFSET CAL_ERR       ;else write error message
                JMP     ERROR                   ;
;
;receive time from server
;
GET_TIME:       MOV     COMMAND,15H             ;Move receive command to NCB
                MOV     BUFFER0,OFFSET CLOCK    ;point buffer to clock area
                MOV     BUFFER0+2,DS            ;initialize segment
                MOV     BUF_LENGTH,08           ;clock needs 8 bytes
                INT     5CH                     ;call netbios
                CMP     AL,00H                  ;check for errors
                JE      HANGUP                  ;if none close the session
                                                ;time and date now in CLOCK
                                                ;area
                MOV     DX,OFFSET RCV_ERR       ;else receive error
                JMP     ERROR                   ;
;
;hangup session
;
HANGUP:         MOV     COMMAND,12H             ;Move hangup command to NCB
                INT     5CH                     ;NetBios call
                                                ;
                MOV     AH,09H                  ;display success
                MOV     DX,OFFSET SUCCESS       ;message to user
                INT     21H                     ;
;
;install the date and time
;
                                                ;
                MOV     CX,YEAR                 ;Prepare to set
                MOV     DH,MONTH                ;the date
                MOV     DL,DAY                  ;using function call
                MOV     AH,2BH                  ;2BH
                INT     21H                     ;
                                                ;
                MOV     CH,HOURS                ;and set the date
                MOV     CL,MINUTES              ;using data in
                MOV     DH,SECONDS              ;clock area
                MOV     DL,HUNDREDTHS           ;using function
                MOV     AX,2D0                  ;call 2D0
                INT     21H                     ;
                JMP     QUIT
;
;error message end closing
;
ERROR:          MOV     AH,09H                  ;write error message to screen
                INT     21H                     ;
                MOV     COMMAND,12H             ;hang-up session if any
                INT     5CH                     ;

QUIT:           RET

NET             ENDP
CSEG            ENDS
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;               message data
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
NETDATA         SEGMENT PARA PUBLIC 'DATA'

STAT_ERR        DB      CR,LF,"GET NAME" COMMAND FAILED',CR,LF,'$'
CAL_ERR         DB      CR,LF,"CALL" COMMAND FAILED',CR,LF,'$'
RCV_ERR         DB      CR,LF,"RECEIVE" COMMAND FAILED',CR,LF,'$'
SUCCESS         DB      CR,LF,'Network clock installed',CR,LF,'$'
SERVER_NAME     DB      'SRV_CLOCK
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;               clock data area
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
CLOCK           EQU     $
YEAR            DW      0000H
MONTH           DB      00H
DAY             DB      00H
HOURS           DB      00H
MINUTES         DB      00H
SECONDS         DB      00H
HUNDREDTHS      DB      00H
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;               message control block data
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
NCB             EQU     $
COMMAND         DB      00H
RETCODE         DB      00H
LSN             DB      00H
NUM             DB      00H
BUFFER0         DB      00H,00H
                DB      00H,00H
BUF_LENGTH      DW      00000
CALLNAME        DB      '*
OUR_NAME        DB      16 dup(0)
RTO             DB      00H
STO             DB      00H
POST0           DB      0000H
                DB      0000H
ADAPTER_NUM     DB      00H
CMD_STAT        DB      00H
RESERVE         DB      14 DUP(0)
;
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
;               buffer for adapter status request
;(Minimum allowable adapter status buffer=60, this program uses only first 6)
;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;;
RETP            EQU     $
ID_NUM          DB      6 dup(0)
FILLER          DB      54 dup(0)
NETDATA         ENDS

STACK           SEGMENT PARA STACK 'STACK'
                DB      32 DUP('STACK   ')
STACK           ENDS

                END
```

The assembly language listing for NETCLOCK.

cilitate communications gateway services between stations on the network.

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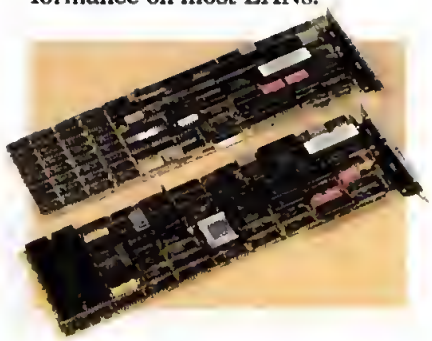

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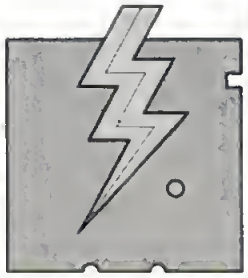
■ EDITED BY CRAIG L. STARK



POWER USER

Setting multiple relations in dBASE III; preventing editing with BROWSE and FREEZE; a WordPerfect place marker; two-monitor SideKick; a rounding error in dBASE III Plus.

JUST LOOKING, THANKS

Dung Quoc Vu's 2SCREEN program (Power User, Volume 6 Number 8) is a clever way to simulate BROWSE within *dBASE* while not allowing the user to edit the fields. A less elegant but sometimes effective alternative is to use the BROWSE command itself, as follows:

```
. BROWSE [FIELDS <field
list>] FREEZE <field>
NOMENU NOAPPEND.
```

[*Note: The above must be entered as a single line.—Ed.*] I've found this is a fast way to program an easy-to-use browsing application. FIELDS <field list> is an optional list of the fields to display. FREEZE allows the user access to only one field. (I've gone as far as to include a 1-byte blank field in my database structure, which is used strictly for FREEZEing.) NOMENU removes access to the BROWSE menu options, so the user can't override your settings. Finally, the NOAPPEND command prevents *dBASE* from appending new records if the cursor is moved below the End-of-File.

In a related application, I've used a logic field called Select to determine which records have been selected for a report. After the user inputs the selection criteria, he can then BROWSE through the database, FREEZEing on Select, to check that the proper records are being used. If there are a few exceptions that need to be included or excluded from the report, the user can change the Select field accordingly.

The *dBASE* BROWSE command takes control over lines 1 through 24, but by SETting SCOREBOARD OFF, the programmer can maintain control over line 0. I use this line for messages such as "Use Ctrl-End to quit the browse mode" so that the novice user doesn't get stuck in BROWSE.

Unfortunately, I don't know of a way within BROWSE to prevent deletion of a record. But my experience is that the real danger in BROWSE is accidental keystrokes rather than deliberate alteration of data, and a Ctrl-U combination is unlikely to be accidental.

Beth J. Katcher
Newton, Massachusetts

I've had several similar responses to Mr. Vu's program that suggest using BROWSE and its FREEZE parameter to let users "look but don't touch." You lose some of 2SCREEN's extras, like the ability to include a custom header, but you can't beat Ms. Katcher's approach for speed. A useful addition might be to include the LOCK parameter so one (or more) key fields would remain visible when the user pans to the right.

■ BROWSE and its FREEZE parameter let users "look but don't touch." A useful addition might be the LOCK parameter.

I couldn't duplicate Ms. Katcher's success in sending messages on line 0 through BROWSE, however. BROWSE clears lines 0 through 21 and 23 when invoked, then issues its own "View and edit" prompts on 22 and 24. If you use SET MENU OFF to show the maximum number of records, a novice may feel trapped in BROWSE—or even panic and shut the machine off with the files open.

It is possible to send the user a custom prompt in BROWSE, but you have to "deep FREEZE" the dummy field. Start with CLEAR and issue your own menu prompt(s) on lines 22 and 24. Then issue the BROWSE command (with FREEZE <dummy fieldname>).

Curiously, your custom prompt line remains intact until BROWSE actually displays the frozen field. If your dummy field is off the screen to the right, the custom prompt stays on until you pan right and display it. If you LOCK enough screen columns that the frozen field can't display—or if the dummy field is too wide (81 columns) to display—the normal "View and Edit Fields" prompt will never replace your custom menu. (An advantage of this approach is that the user is never distracted by the reverse-video dummy field.)

Note that these alternatives to 2SCREEN.PRG apply only to dBASE III Plus*; the older* dBASE III *supports FREEZE but not the other parameters.*—Brad Stark

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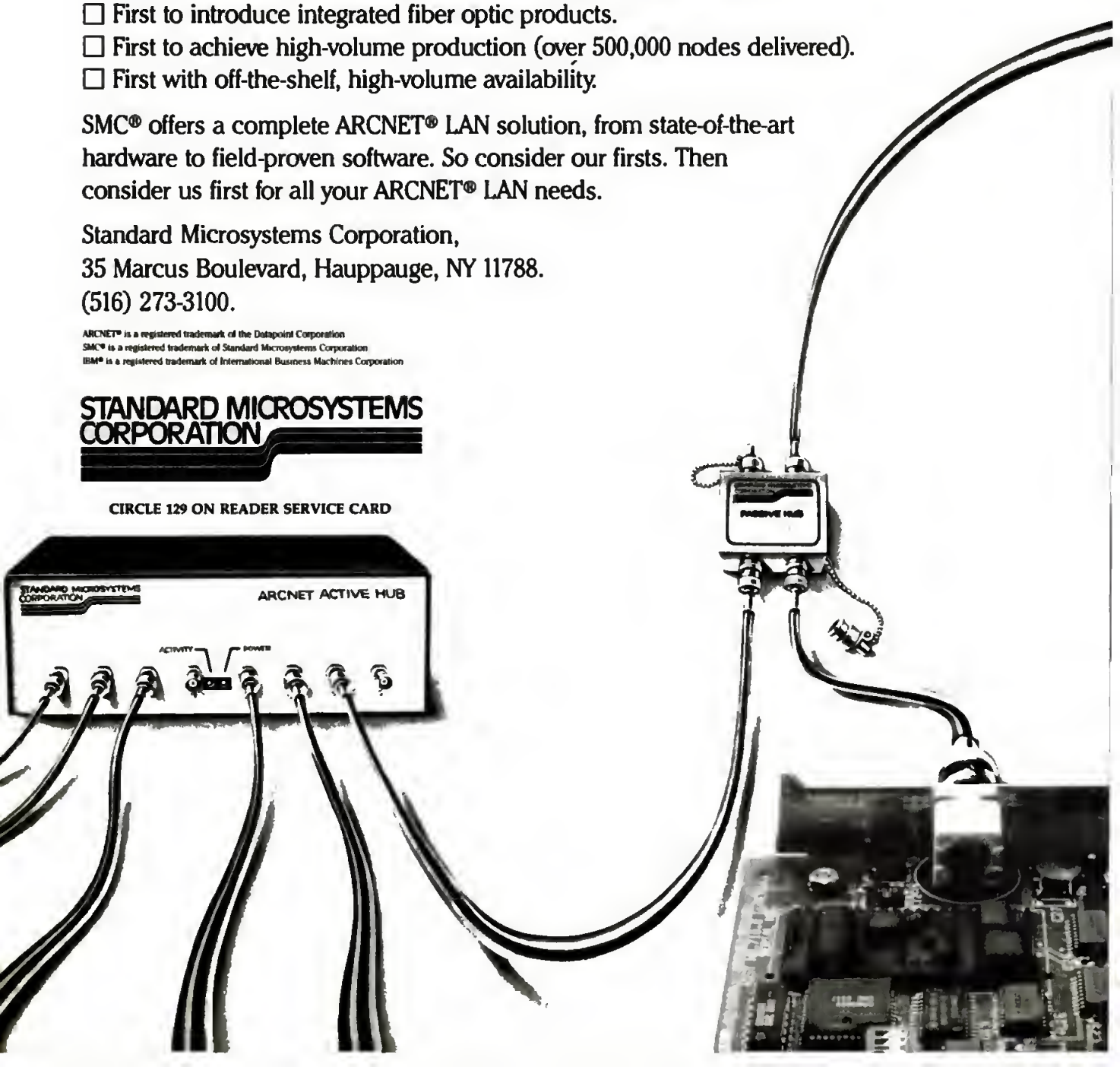


■ POWER USER

WHERE WAS I?

When you exit *WordPerfect* before finishing editing a file, you lose your place: when you later retrieve the file, the cursor is at the beginning of the document. The simple solution is to type in a special character at the cursor before saving the file. I use the caret (^), since I never use that symbol in my text.

When I retrieve the document, I invoke the macro Alt-F, which automatically finds the caret and backspaces over it, deleting it and leaving the cursor where it was before I saved the document. Alt-F consists of the following keystrokes:

```
<Home><Home><Up Arrow>
F2^<Esc>
<Backspace>
```

Shirley Anderson
San Jose, California

As with most WordPerfect *macros, this tip can be applied to* Microsoft Word, WordStar, *or any other word processor that will work with* SuperKey, ProKey, *or the like. The one addition I would make is to automate the process of inserting the caret when saving. In* WordPerfect, *you might create the macro Alt-E (for exit):*

```
^ F7 Y Ret Y
```

This translates to type the caret, then Exit, Yes save, accept the old name, and Yes overwrite the old file. This macro, of course, can also be applied to other word processors with appropriate changes in the commands.—M. David Stone

TWO-MONITOR SK

SideKick provides a useful, undocumented feature for PCs with two monitors—an increasingly common situation as EGA monitors are added to monochrome systems. Start *SideKick* on one monitor, switch to the other with a MODE command, and run a program. *SideKick* will always come up on the monitor you started on, and your other monitor screen will remain intact, including cursor position. This lets you neatly do two different things on your two monitors, and it is much more useful than adding an extra window on an all-too-small PC display.

Granio A. Korn
Tucson, Arizona

Unfortunately, this trick is more limited than Mr. Korn suggests, and it should be used with care. If you have both EGA and monochrome monitors, and you install SideKick *for a default screen,* SideKick *will show up on the current monitor when you call it up—regardless of where you were when you originally loaded it. Instead, you must install the program for either a color monitor or a monochrome monitor connected to a CGA card.* SideKick *will then always show up on the color screen, regardless of the current mode or your mode when you loaded it.*

This does allow you to run another program on the monochrome monitor, as Mr. Korn suggests, but when you leave SideKick, *the display on your monochrome monitor gets blanked out. In some cases, you can rewrite the screen with a PgUp or PgDn commond, but failing that, you have to drive blind until the program rewrites the screen for you. It would be nice to use the monochrome screen for* SideKick *and the EGA for your main program, but that won't work. If you install* SideKick *for the monochrome screen,* SideKick *will automatically throw you into monochrome mode when you load it, and it will crash your system if you try calling it up while in color mode.*—M. David Stone

■ If you install *SideKick* for the monochrome screen, *SideKick* will automatically throw you into monochrome mode when you load it.

MAKING F1 THE "IN" KEY

The PC's function keys are a natural device for soliciting the user's choice in a menu. The one problem is that *dBASE* preempts control of the F1 key for its own Help system, so you can't SET FUNCTION 1 TO anything.

With *dBASE III Plus*, however, there's a work-around. Use the INKEY() function (instead of a conventional GET or ACCEPT) to solicit the user's menu choice and route the program accordingly. For example, INKEY() returns a value of 28 if F1 is pressed inside the following DO WHILE loop:

```
i=0
DO WHIL i=0
  i=INKE()
ENDD
DO CASE
CASE i=28          && F1 was pressed
  DO CHOICE1
CASE i=-1          && F2 was pressed
  DO CHOICE2       && etc.
ENDCASE
```

Note that INKEY() returns some strange values for function keys, number keypad, and control characters. The program below will display the INKEY() value of any keypress:

```
SET TALK OFF
i=0
DO WHIL .NOT. i=27
  i=0
  @ ROW(),26 SAY "INKEY() = "
  DO WHIL i=0
    i=INKE()
  ENDDO
  ?? STR(i,3)
ENDDO
```

Steve Westwood
Shearwater, Nova Scotia
Canada

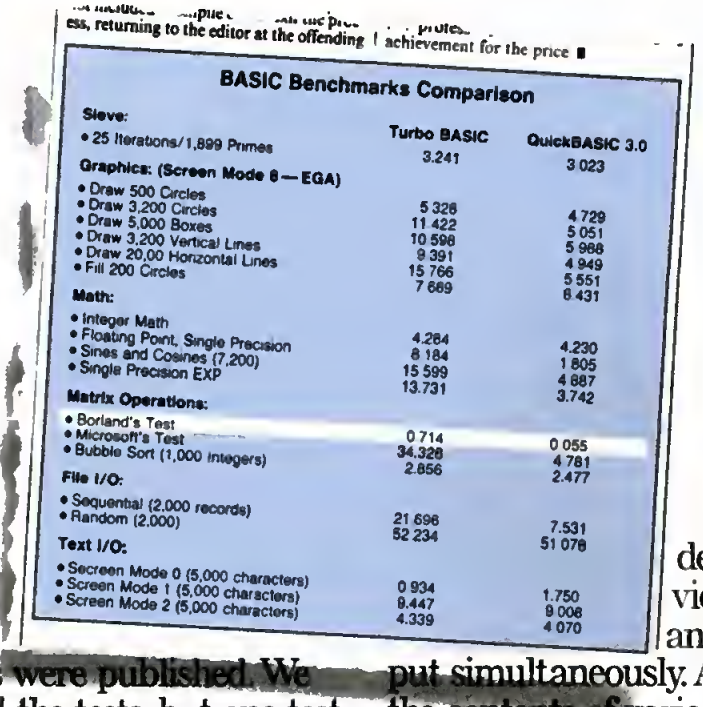
He likes the function keys, she wants mnemonic letters, the boss wants numbers, and the guy in the back row insists on a highlighted menu bar.

If you're willing to go through the exercise, Mr. Westwood's INKEY() method can be used to satisfy just about everyone. For example, suppose the first menu choice is "Goto the next record." The CASE statements will have to reflect all the possible responses: F1, G, g, and the numeral 1 from the upper keyboard row or the number pad. The INKEY() values of these keypresses are 28, 71, 103, 49, and 6. With a long group like this, it's economical to convert the INKEY() possibilities into a character string and test that way:

```
CASE STR(i,3)$" 28, 71,103, 49,  6"
```

I've seen menu bar applications in dBASE, *but they're slow and bulky.* Clip-

Microsoft QuickBASIC 3.0's speed was verified by an indisputably independent test.



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BASIC Benchmarks Comparison

	Turbo BASIC	QuickBASIC 3.0
Sieve:		
• 25 Iterations/1,899 Primes	3.241	3 023
Graphics: (Screen Mode 8 — EGA)		
• Draw 500 Circles	5 326	4 729
• Draw 3,200 Circles	11 422	5 051
• Draw 5,000 Boxes	10 598	5 968
• Draw 3,200 Vertical Lines	9 391	4 949
• Draw 20,00 Horizontal Lines	15 766	5 551
• Fill 200 Circles	7 669	8 431
Math:		
• Integer Math	4.264	4.230
• Floating Point, Single Precision	8 184	1 805
• Sines and Cosines (7,200)	15 599	4 887
• Single Precision EXP	13.731	3.742
Matrix Operations:		
• Borland's Test	0 714	0 055
• Microsoft's Test	34.328	4 781
• Bubble Sort (1,000 integers)	2.856	2.477
File I/O:		
• Sequential (2,000 records)	21 696	7.531
• Random (2,000)	52 234	51 078
Text I/O:		
• Secreen Mode 0 (5,000 characters)	0 934	1.750
• Screen Mode 1 (5,000 characters)	9.447	9 008
• Screen Mode 2 (5,000 characters)	4.339	4 070

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■ POWER USER

per's *built-in menu bar system is preferable and works just like* 1-2-3, *complete with a changing information line.*
—Brad Stark

IT COULDN'T BE DONE

It's often frustrating that *dBASE III* cannot set multiple relationships from one master file into several reference files.

This would save a lot of programming (and execution time) when, for example, a sales transaction file contains codes for both customer and part number, and you need to pull data from both lookup files. Unfortunately, per the manual, "only one relation can be set from each work area."

I've discovered a method that *does* allow *dBASE* to simulate multiple relations from one parent into two or more children files. The key concept involves using the parent file's ALIAS. Assuming the above example, the file setup sequence is:

```
SELE A
  USE transact
SELE B
  USE cust INDE custno
SELE C
  USE parts INDE partno
SELE A
  SET RELA TO custno INTO B
SELE B
  SET RELA TO A->partno INTO C
SELE A
```

Notice that the second SET RELA TO takes place in Area B, but that it has *nothing* to do with the Area B file. Functionally, a "one parent–two children" relation is created. Each time a new parent record is accessed, the first relation automatically FINDs the corresponding customer record, and the second relation automatically FINDs the parts record related to A–>partno.

As many as four lookup files can be related in this way to a single parent: the limit is based on *dBASE*'s maximum of ten open files.

John R. Gardner
Memphis, Tennessee

dBASE *does some nimble tricks to make this "funny uncle" relationship work. I'm impressed that it doesn't choke—much less that it actually yields successful results—when the second relation is set. But Mr. Gardner's creative idea works well in both* dBASE III *and* dBASE III Plus.

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CIRCLE 121 ON READER SERVICE CARD

■ POWER USER

By way of explanation, when dBASE *processes the relationship SET in Area B, it dutifully notes that what it should FIND in Area C is the part number in Area A.* dBASE*'s designers never expected the program to be used in this way, so the code must be very robust to break new ground.*

Another delightful result is that, even if the first relation doesn't FIND successfully in Area B (which is then at End-of-File), the second relationship into Area C will still be processed. Not so surprising, on reflection, since the value of A–>partno stays the same no matter what's going on in Area B.—Brad Stark

A ROUND() ABOUT ANSWER

A peculiarity with *dBASE III Plus* is that while its ROUND() function properly rounds 5.5 up to 6.0, −5.5 gets rounded to −5.0, not to −6.0. If you're not careful, offsetting accounting entries will not balance whenever ROUND() must make a decision precisely halfway between two values.

The ABS() function is a good work-around. For example, when multiplying gross and rate to find commission, enter

```
. comm=ROUN(ABS(gross)
   *rate,0)*ABS(gross)/gross
```

[*The above must be entered as a single, unbroken line.—Ed.*] The first half calculates the absolute value of the commission; dividing absolute gross by gross provides the correct sign.

Incidentally, I have not encountered a similar problem with Lotus's *1-2-3*.

Brian Danenberg
San Francisco, California

Lotus is right: decimals of .5 or greater should "round up" to the next larger integer. dBASE III Plus *properly rounds negative numbers from −5.51 through −5.9 "up" to −6.0 and should do the same for −5.5.*—Brad Stark

DROP CAPS WITH WORD

Drop caps, in which the first letter in a paragraph is larger than the remaining text, are a standard element of many reports, brochures, and newsletters. *Microsoft Word* will let you print drop caps by combining the side-by-side paragraph feature with your printer's larger type fonts.

Type a return after the first letter of the paragraph. Highlight that character and press <Esc>-F(ormat)-P(aragraph). Set the right indent to be .3 to .5 inches less than the current line length—the actual amount will depend on the type size you choose. Next, set the "line space" field to a value that is half the point size of the font. For example, set to "9 pt" for an 18-point font. Set the "side-by-side" field to yes. Then press Enter.

With the character still highlighted, hold down the Shift key and press Enter. This forces the character into the drop-cap pocket. Then press <Esc>-F(ormat)-C(haracter) and format the character to the font and point size you desire.

■ While the *dBASE III Plus* ROUND() function properly rounds 5.5 up to 6.0, −5.5 gets rounded to −5.0. The ABS() function is a good work-around.

Next, highlight any portion of the full paragraph and press <Esc>-F-P again. Set the left indent to .3 (to .5) inches, the right indent to 0, line spacing to 1 line, and side-by-side paragraph to yes. To get the text to wrap around the drop cap, select the first character of the third line and press return. Format this as a normal paragraph, with no indent left or right and with side-by-side set to no.

This method works best with flush-left layouts. The measurements given are suggestions only, and will vary with different fonts and point sizes.

David M. H. Butler
Seattle, Washington

This trick obviously works best for laser printers. Be aware, too, that it won't work unless you have a large range of font sizes available. With the IBM Graphics Printer, for example, Word *only gives you the range from 8 to 16 points, which doesn't give you a large enough first letter for the desired effect. Also, this is probably more work than you want to do on a regular basis.* [Now you'll appreciate the value of a page layout program!—Ed.] *Once you've determined the proper settings, you might like to automate the procedure with a macro, using* ProKey *or the like.*
—M. David Stone

RUNNING PROGRAMS FROM WORD

While *Microsoft Word*'s Escape Library Run command lets you run DOS commands, it returns you to *Word* after a single command. This makes it impossible to run a program if you must change directories first. It's also clumsy if you have to run several commands—looking at the directory and erasing individual files to free disk space, for example.

You can obviate this difficulty simply by issuing COMMAND as the command to run. This loads a second COMMAND.COM and lets you issue as many commands as you like. When finished, just type EXIT to return to *Word*. For safety's sake, however, I recommend you save your *Word* document before doing this.

Ronny Richardson
Chamblee, Georgia

You can work this trick with any program that lets you run a DOS command reliably. In fact, you can run as many layers of COMMAND.COM and programs as will fit in memory, then exit your way back to the original program you started with, layer by layer. Alas, the trick does not work with WordStar *3.3's flaky Run a Program command, but it does work with* WordStar, *Version 4.0.*—M. David Stone

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CIRCLE 179 ON READER SERVICE CARD

■ PAUL SOMERSON

USER-TO-USER

Create a couple of utilities that set colors and clear 43-line EGA screens; and how to tell your programs what kinds of displays you're using.

EGA COLOR CLS

In Volume 5 Number 15, Charles Petzold created an EGA-aware clear-screen program called CS.COM. It's simple to add 3 bytes to adapt his program so that it will set the colors in addition to blanking the screen.

In the listing for the original CS.COM program (Figure 1) INT 10H is called a fifth time, with AX=0600, to clear the screen. The BX register was left untouched to preserve the existing screen colors. To color your screen, simply load the BX register with your favorite color attributes before AX is loaded. Then, when INT 10H is invoked to clear the screen, BX will color your screen.

To do this, add the single line

```
MOV BX,#@00
```

where # represents the hex value of the background color and @ represents the hex value of the text color. For bright yellow (E) text on a red (4) screen, the instruction would be

```
MOV BX,4E00
```

If you try this, add the new line right below the SUB CX,CX and above the MOV AX,0600, so that part of the listing looks something like

```
SUB CX,CX
MOV BX,4E00
MOV AX,0600
```

Then adjust the file length by changing the 42 directly above the W to 45.

J. K. Bane
Pittsburgh, Pennsylvania

Be careful when picking a color not to choose a background (the left-hand digit represented by the #) higher than 7. This is a handy program, since the normal DOS CLS won't clear more than 25 lines, and many users work in the EGA 43-line mode.

However, while the CS.COM program will clear a 43-line EGA screen, it changes

```
N CS.COM
A
MOV  DL,18
SUB  BH,BH
MOV  AX,1130
INT  10
MOV  AH,0F
INT  10
DEC  AH
MOV  CH,DL
MOV  CL,AH
MOV  AH,00
CMP  AL,07
JZ   011D
CMP  AL,03
JA   012D
MOV  DL,20
MOV  AH,02
INT  21
MOV  AL,08
MOV  AH,0E
INT  10
MOV  AH,08
INT  10
PUSH BX
MOV  BH,AH
MOV  DX,CX
SUB  CX,CX
MOV  AX,0600
INT  10
POP  BX
SUB  DX,DX
MOV  AH,02
INT  10
INT  20

RCX
42
W
Q
```

Figure 1: *CS.SCR script for EGA-oware screen-clearing program. Hit the Enter key after typing each line, especially the last one, and leave a blank line above RCX. Put this file in the same directory as DEBUG.COM, Version 2.0 or later, and type DEBUG<CS.SCR to create it. To add a screen color, right below the SUB CX,CX and above the MOV AX,0600 lines, add the line MOV BX,#@00 (where # represents the hex value of the background color and @ represents the hex value of the text color; for bright yellow (E) text on a red (4) screen, the instruction would be MOV BX,4E00). Then change the 42 on the third line from the bottom to 45.*

```
100 ' CLSEGA.BAS -- creates CLSEGA.COM (EGA 43-line color CLS)
110 ' based on C. Petzold's EGA43.COM -- for EGAs only !
120 DIM H(80):FOR A=1 TO 80:READ A$:B(A)=VAL("&H"+A$)
130 T=T+(H(A)):NEXT:IF T<>7757 THEN PRINT "DATA ERROR":END
140 COLOR 3,0:CLS:PRINT "Pick background:":COLOR 0,7:PRINT "0";
150 COLOR ,0:FOR A=1 TO 7:COLOR A,0:PRINT STR$(A);:NEXT:PRINT
160 C$=INPUT$(1):IF INSTR("01234567",C$)=0 THEN 140 ELSE B$=C$
170 COLOR 3:PRINT "Pick foreground: "
180 COLOR 0,7:PRINT "0";:COLOR ,0:PRINT CHR$(32);
190 FOR A=1 TO 15:COLOR A,0:PRINT HEX$(A);CHR$(32);:NEXT:PRINT
200 C$=INPUT$(1):IF INSTR("0123456789ABCDEFabcdef",C$)=0 THEN 140
210 IF C$=B$ THEN 170 ELSE H(43)=16*VAL("&H"+B$)+VAL("&B"+C$)
220 OPEN "CLSEGA.COM" AS #1 LEN=1:FIELD #1,1 AS D$
230 FOR B=1 TO 80:LSET D$=CHR$(H(B)):PUT #1:NEXT:CLOSE:END
240 DATA B8,12,11,B3,00,CD,10,29,C0,8E,D8,FF,36,87,04,80
250 DATA 0E,87,04,01,B9,00,06,B4,01,CD,10,8F,06,87,04,BA
260 DATA B4,03,B8,14,07,EF,B8,00,06,B7,5E,31,C9,BA,4F,2A
270 DATA CD,10,B4,02,30,FF,31,D2,CD,10,CD,20,74,03,C6,07
280 DATA 00,A0,67,46,32,06,69,46,22,C5,22,C1,74,03,C6,07
```

Figure 2: *CLSEGA.BAS creates CLSEGA.COM to set EGAs in 43-line mode, set user-defined colors, and clear the screen.*

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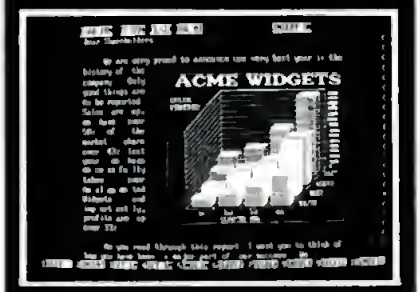

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the current number of lines. If you want a single program to set the number of lines on an EGA screen to 43, set the colors, and then clear the screen, you can adapt Petzold's EGA43.COM routine. The CLSEGA.BAS program in Figure 2 will ask you for the colors you like and create a custom CLSEGA.COM file for you.

EGA DETECTOR

With EGAs increasing in popularity, programmers now have to test for them in addition to MDAs and CGAs. Unfortunately, IBM has not made it easy to identify the presence (and, more importantly, the activity) of an EGA.

Version 2.0 of *Microsoft Word* was one of the first programs to take advantage of the EGA. However, the method it used to detect the presence of an EGA was both awkward and unsupported by IBM. Embedded near the beginning of IBM's EGA ROM BIOS, at location C000:001E, are the letters "IBM". *Word* 2.0 tests for the presence of these letters in the copyright notice, and if they are found it assumes that an EGA is available.

It's curious that Microsoft chose this method, as IBM includes a warning in the EGA *Technical Reference* manual about a similar misuse of its BIOS. At location C000:0000, a 2-byte signature appears (0AA55H) that identifies a valid adapter ROM module to the POST routine. IBM explicitly states in the documentation that this signature is *not* to be used as an EGA presence test. However, if you were to disassemble the MODE command (which allows the user to, among other things, set the mode of the video adapter or change monitors in a two-monitor system), you would find the code fragment shown in Figure 3.

Here, IBM disobeys its own warning and uses the BIOS signature to test for the presence of an EGA card.

A far more conventional test for the presence of an EGA is to use the extended BIOS features available in the EGA's ROM. When an EGA is present, interrupt 10H (the video interrupt) is vectored to the EGA's ROM, and interrupt 42H is used to revector the old planar ROM video interrupt. Thus, the extra EGA features are available through interrupt 10H.

■ With MODE, IBM disobeys its own warning and uses the BIOS signature to test for the presence of an EGA card.

One of these extended features is called Alternate Select. Its major function is to select the Alternate Print Screen routine,

```
MOV     AX,0C000H               ; move segment address..
MOV     ES,AX                   ; into es register
CMP     WORD PTR ES:0,0AA55H    ; is it the signature ?
JNZ     ...                     ; jump if true
```

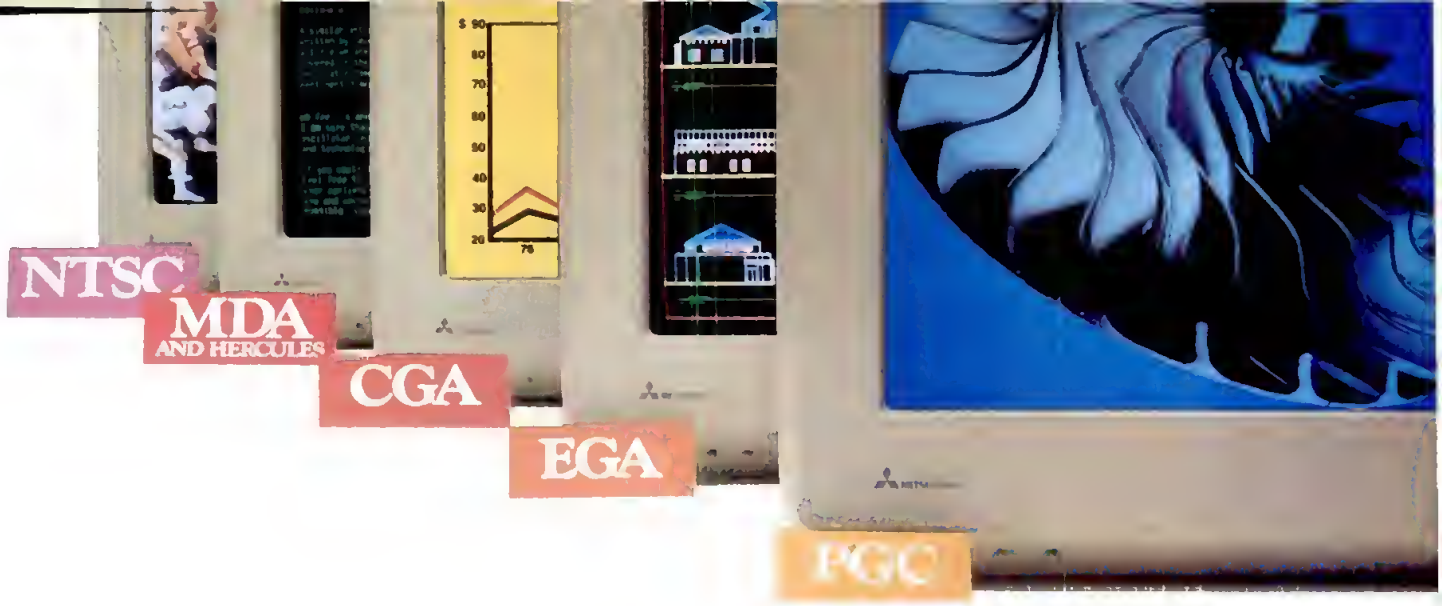
Figure 3: *Code fragment from MODE.COM that tests for EGA ROM.*

```
        MOV     AH,12H                  ; function 12H
        MOV     BL,10H                  ; subfunction 10H
        INT     10H                     ; video interrupt

This function returns the following information:

        Register            Description
        --------            -----------------------------
        BH                  mode in effect (color or mono)
        BL                  memory on EGA (01H=64k, 02H=128k, etc.)
        CH                  feature bits
        CL                  EGA switch settings
```

Figure 4: *Code fragment used to request EGA information, and table to interpret codes returned.*



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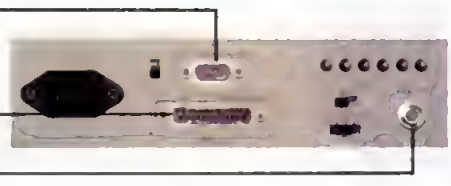

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```
BMASK       EQU     00001000B               ; MASK FOR INFO BYTE (EGA ACTIVE)
BIOS_DATA   SEGMENT AT 40H                  ; ROM BIOS DATA AREA
            ORG     87H
INFO        DB      ?                       ; EGA INFO BYTE
BIOS_DATA   ENDS

CODESEG     SEGMENT PARA PUBLIC 'CODE'
            ASSUME CS:CODESEG
            ORG     100H                    ; HUNT FOR COM FILES
BEGIN:
            PUSH    CS                      ; DATA SEGMENT = CODE SEGMENT
            POP     DS
            ASSUME DS:CODESEG

            MOV     AH,12H                  ; FUNCTION 12H (ALTERNATE SELECT)
            MOV     BL,10H                  ; SUB-FUNCTION 10H (RETURN EGA INFO)
            INT     10H                     ; VIDEO INTERRUPT
            CMP     BL,10H                  ; BH BL CHANGED?
            JNE     EGA_BIOS                ; YES, SO WE HAVE AN EGA PRESENT
            LEA     DX,NO_EGA               ; NO, LOAD ADDRESS OF NO EGA MESSAGE
            JMP     SHORT DISPLAY_MSG
EGA_BIOS:
            MOV     AX,BIOS_DATA            ; MOVE THE BIOS_DATA SEGMENT TO AX..
            MOV     DS,AX                   ; ..AND INTO THE DATA SEGMENT
            ASSUME DS:BIOS_DATA
            MOV     AH,INFO                 ; GET INFO BYTE FROM ROM DATA AREA
            PUSH    CS
            POP     DS                      ; RETURN TO DATA SEG = CODE SEG
            ASSUME DS:CODESEG
            AND     AH,BMASK                ; ISOLATE EGA ACTIVE BIT
            JNE     EGA_NOT_ACT             ; EGA DOES NOT HAVE ACTIVE MONITOR
            CMP     BH,0                    ; IS MONOCHROME CONNECTED TO EGA?
            JNE     EGA_MONO                ; YES, SO DISPLAY MONO MESSAGE
            LEA     DX,ACTIVE_COLR          ; NO, SO DISPLAY COLOR MESSAGE
            JMP     SHORT DISPLAY_MSG

EGA_NOT_ACT:
            LEA     DX,NOT_ACTIVE           ; LOAD ADDRESS OF NOT-ACTIVE MESSAGE
            JMP     SHORT DISPLAY_MSG

EGA_MONO:
            LEA     DX,ACTIVE_MONO          ; LOAD ADDRESS OF MONO MESSAGE

DISPLAY_MSG:
            MOV     AH,09                   ; FUNCTION 9H (PRINT)
            INT     21H                     ; DOS FUNCTION CALL
            INT     20H                     ; WE'RE FINISHED

NO_EGA      DB      $DH,$AH,'EGA not present',$DA,$Ah,'$'
NOT_ACTIVE  DB      $DH,$AH,'EGA present but not active',$Dh,$Ah,'$'
ACTIVE_MONO DB      $DH,$AH,'EGA active with monochrome monitor',$Dh,$Ah,'$'
ACTIVE_COLR DB      $DH,$AH,'EGA active with color monitor',$Dh,$Ah,'$'
```

Figure 5: *EGATEST.ASM listing to create EGATEST.COM.*

but another of its functions is to return EGA information. Figure 4 shows the assembler code segment that can be used to request EGA information and the information that this function will return.

But how can this help us to identify the presence of an EGA? Note that the BL register is used both on input and to return a value. The standard ROM BIOS interrupt 10H does not have a function 12H, so the BL register is returned intact if there is no EGA. Fortunately, if there is an EGA, the BL register will return a value of 0H, 1H, 2H, or 3H, depending on the memory size, but cannot return a value of 10H. If the BL

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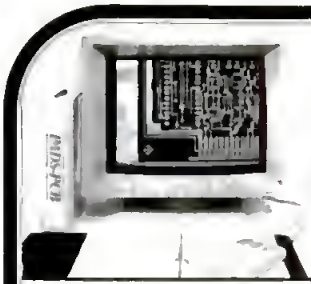

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register has changed, an EGA is present.

This procedure can be used to identify the presence of an EGA, but does not inform us if the EGA is active. If the EGA is connected to a color or enhanced color display, we can also have a monochrome adapter and monitor installed. Conversely, if the EGA is connected to a monochrome display, we can also install a CGA and color monitor. If we are going to write any hardware-dependent routines, we must take into consideration the possibility of a two-monitor system.

IBM does not provide a video function that allows us to determine which adapter is active if there is more than one installed. However, we can use the information in the ROM BIOS data area to determine if the EGA is the active adapter. At absolute location 487H, IBM defines a byte used to store EGA information. Bit 3 of this byte (using the notation that bit 0 is the low-order bit) informs us if the EGA is the active

```
100 ' Program for creating EGATEST.COM -- Terry P. Sanderson
110 CLS:PRINT "Checking DATA; please wait..."
120 FOR B=1 TO 12:FOR C=1 TO 16:READ A$:TTL=TTL+VAL("&H"+A$):NEXT
130 READ S:IF S=TTL THEN 150
140 PRINT "DATA ERROR IN LINE";B*10+190;" -- REDO":END
150 TTL=0:NEXT:RESTORE
160 OPEN "EGATEST.COM" AS #1 LEN=1:FIELD #1,1 AS D$
170 FOR B=1 TO 12:FOR C=1 TO 16:READ A$
180 LSET D$=CHR$(VAL("&H"+A$)):PUT #1:NEXT:READ DUMMY$:NEXT
190 CLOSE:PRINT "EGATEST.COM CREATED"
200 DATA 0E,1F,B4,12,B3,10,CD,10,80,FB,10,75,06,8D,16,3E,1402
210 DATA 01,EB,25,B8,40,00,8E,D8,8A,26,87,00,0E,1F,80,E4,1591
220 DATA 08,75,0B,80,FF,00,75,0C,8D,16,98,01,EB,0A,8D,16,1372
230 DATA 52,01,EB,04,8D,16,71,01,B4,09,CD,21,CD,20,0D,0A,1286
240 DATA 45,47,41,20,6E,6F,74,20,70,72,65,73,65,6E,74,0D,1388
250 DATA 0A,24,0D,0A,45,47,41,20,70,72,65,73,65,6E,74,20,1107
260 DATA 62,75,74,20,6E,6F,74,20,61,63,74,69,76,65,0D,0A,1391
270 DATA 24,0D,0A,45,47,41,20,61,63,74,69,76,65,20,77,69,1188
280 DATA 74,68,20,6D,6F,6E,6F,63,68,72,6F,6D,65,20,6D,6F,1583
290 DATA 6E,69,74,6F,72,0D,0A,24,0D,0A,45,47,41,20,61,63,1071
300 DATA 74,69,76,65,20,77,69,74,68,20,63,6F,6C,6F,72,20,1523
310 DATA 6D,6F,6E,69,74,6F,72,0D,0A,24,00,00,00,00,00,00,835
```

Figure 6: *EGATEST.BAS program to create EGATEST.COM.*

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adapter. If this bit is 0, the EGA has the active monitor; if it is 1, another adapter card is active.

Following this, we should again look at the values returned by the previous video function call. Register BH returns a value of 0H if the EGA is connected to a color monitor, and a value of 1H if a monochrome monitor is attached. Combining this information, we can finally determine which adapter *is* active.

■ You can assemble EGATEST.ASM or run EGATEST.BAS to create a short .COM program to check for the presence and activity of an EGA.

You can assemble the EGATEST .ASM listing in Figure 5, or run the BASIC EGATEST.BAS program in Figure 6 to create a short EGATEST.COM program to check for the presence and activity of an EGA.

Terry P. Sanderson
Toronto, Ontario
Canada

Programmers can adapt this to put appropriate error codes into AL, terminate with function 4CH, and trigger an IF ERRORLEVEL test. Or they can incorporate this basic code into their own programs. Either way, it's a shame IBM or Microsoft didn't make the process a whole lot easier.

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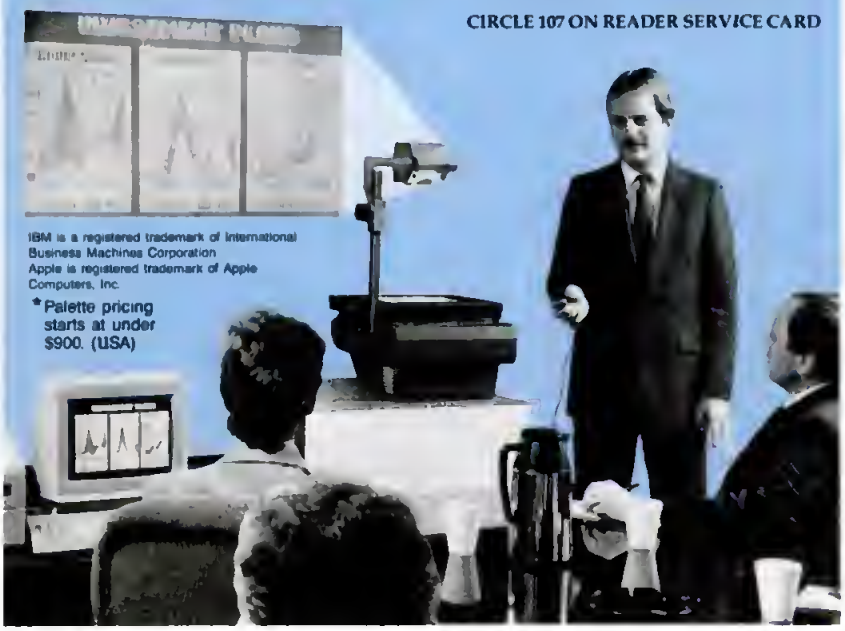

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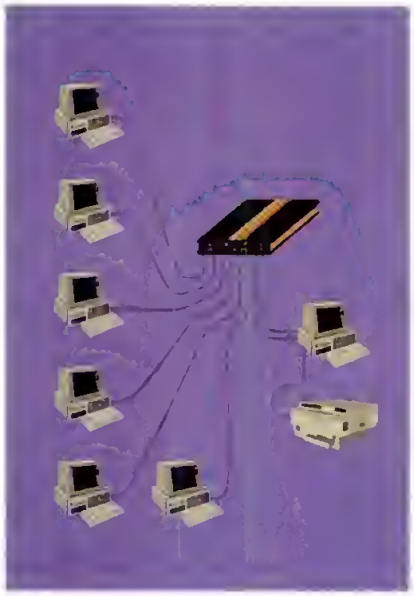

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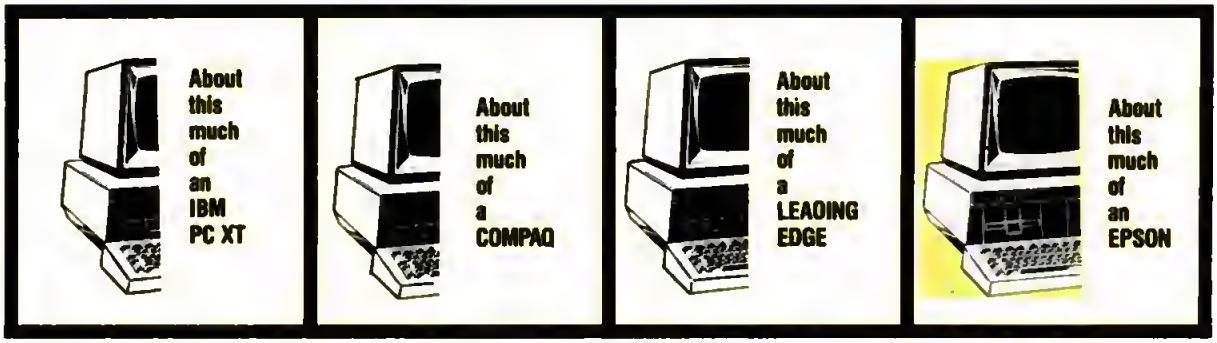

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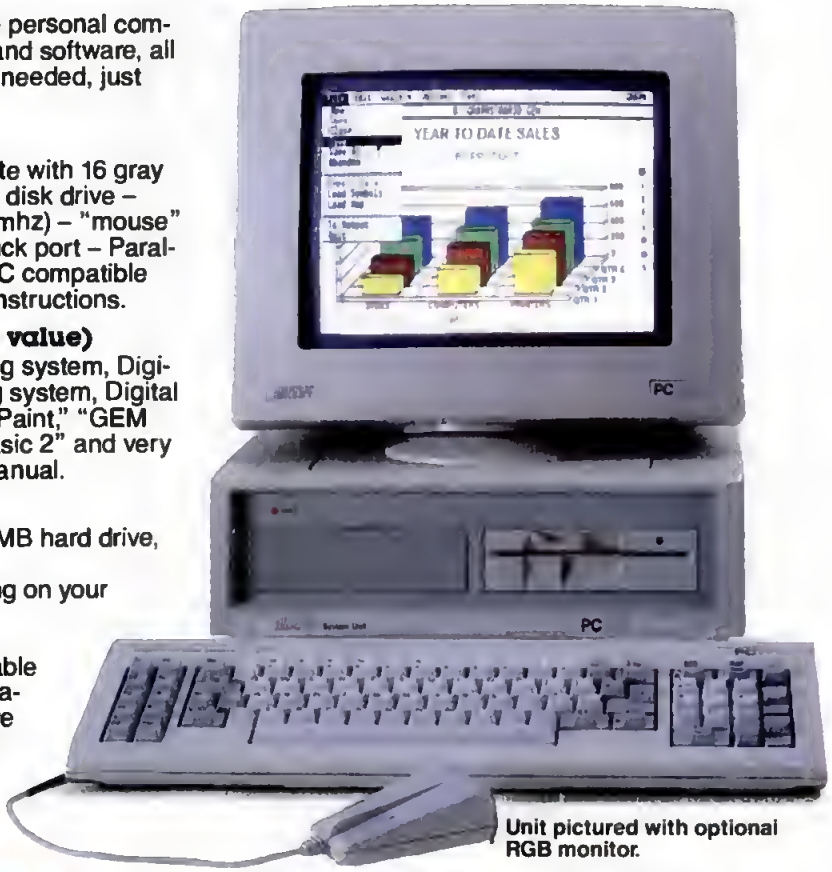

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■ CHARLES PETZOLD

PC TUTOR

From transistor gates to assembly language instructions, this is the clearest explanation of a computer's logical operations you're ever likely to find.

CHOMPING AT THE BITS

The two assembly language mnemonics I find most confusing are AND and OR. I gather these two statements manipulate data at the bit level, not the byte level. But all the assembly language books I have seen tell me only that these mnemonics perform "logical" ANDs and ORs on the operands—no great help to novices who aren't even sure what that means.

What do AND and OR do?

Gerald A. Monroe
Lakewood, Ohio

Logical operations such as AND ond OR represent the fundamental building blocks of digitol computers. To get a good feel for what these operotions are oll obout, let's begin by discussing bits. A bit is the simplest form of information becouse it can exhibit only one of two states. You con think of a bit as being either Yes or No, On or Off, True or Folse, 1 or 0.

Although the subject of bits and logical operations is sometimes approached in on abstract mathematicol manner, bits are very reol. In the hardware of digitol computers, such as the PC, virtually every interconnection is a "bit corrier." The wires, the connections between chips on the circuit boards, the connections within the chips themselves—all these connections carry signols in the form of a voltage. This voltage represents a bit. In much of the hardware of the PC, o 1 bit is represented by o 5-volt signal and o 0 bit is represented by a zero-volt signal.

For instonce, the 8088 microprocessor chip in the PC ond PC-XT hos 20 pins that are used to oddress the memory chips. If you were able to "freeze" the operation of the PC and use a voltmeter to measure the voltoges on these 20 pins, you would find that eoch pin would measure either 0 volts (approximotely) or 5 volts (approximately). From these meosurements you could then figure out the 20-bit address the 8088 was outputting to the memory chips.

The various integroted circuit chips on the board manipulate or process data in the form of bits. They receive signals from other chips ond send signals out to other chips. Regordless of the complexity of these chips, they all contoin transistors wired together into smoll fundomentol "logic gotes." These gotes take two input signals (i.e., two bits) and creote from them an output signal (another bit).

One simple logic gote is colled the OR gote. The input to this gate consists of two signals (coll them A ond B), eoch of which can be either o 0 or a 1. The output is a 1 if either A or B is a 1. You can represent this by o formulo:

```
A OR B
```

You con summarize what an OR gate does with o smoll table. This table (ond the others like it in this orticle) read from left to right as follows: For line 1, if the A state is 0 and the B state is 0, then the result of A OR B is 0. For line 2, if the state of A is 0 ond the state of B is 1, then the result of A OR B is 1, and so on.

A	B	A OR B
Ø	Ø	Ø
Ø	1	1
1	Ø	1
1	1	1

In theory, only two tronsistors are required to construct an OR gote. You con think of the trousistors os switches, one for each of the inputs. The transistors ore wired in parollel so that the output is on (a 1 bit) if either switch is turned on.

A second simple gote is colled the AND gate. The output to this gote is o 1 only if both *inputs are 1. Here's the formula:*

```
A AND B
```

Here's the table:

A	B	A AND B
Ø	Ø	Ø
Ø	1	Ø
1	Ø	Ø
1	1	1

This gate can also be constructed (in

■ Although the subject of bits and logical operations is sometimes approached in an abstract manner, bits are very real.

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■ PC TUTOR

theory) from only two transistors, where the two transistors are wired in series. Like switches that are wired in series, the output will be on (a 1 bit) only if both switches are turned on.

Another important (although seemingly trivial) logical operator is called NOT. This takes one input, which I'll call A. If A is a 0, NOT changes it to a 1. If A is a 1, then NOT changes it to a 0:

A	NOT A
0	1
1	0

Within an integrated circuit, the output from an OR gate can be the input to a NOT, so they can function together as represented by this formula:

```
NOT (A OR B)
```

This is called a NOR gate, so we can also represent this as

```
A NOR B
```

Here's what its table looks like:

A	B	A NOR B
0	0	1
0	1	0
1	0	0
1	1	0

The result is simply an inversion of the OR table results—the 0's in the OR table are 1's in the NOR table, and 1's in the OR table become 0's in the NOR table.

Similarly, an output from an AND gate can feed into a NOT to construct a NAND gate. The formula

```
A NAND B
```

is the same as

```
NOT (A AND B)
```

and has the following table:

A	B	A NAND B
0	0	1
0	1	1
1	0	1
1	1	0

You may start to see some relationships between all these tables. For instance, if you turn the third column of the OR table upside down, it looks like the third column of the NAND table. That leads to the conclusion that

```
A OR B = (NOT A) NAND (NOT B)
```

Similarly,

```
A AND B = (NOT A) NOR (NOT B)
```

TEACHING TRANSISTORS TO ADD

Let me stress again that these logical operations are not solely mathematical exercises but actually perform vital functions in the PC's hardware. The transistors in the integrated circuits are wired together to form little logic gates. The individual logic gates are wired together to do more-complex tasks, often within the same chip.

I want to demonstrate this real-life applicability. As you know, a computer can add two numbers together. We take this for granted nowadays, but once you start looking at the computer in terms of logic gates, it no longer seems trivial. How can transistors add?

You first must wire together an OR gate, an AND gate, and a NAND gate. You start with two inputs and run them into both the OR gate and the NAND gate. The output from the OR gate and the output from the NAND gate become the inputs to the AND gate. This connection can be symbolized by the formula

```
(A OR B) AND (A NAND B)
```

This is called an "exclusive OR" gate, often abbreviated XOR. Instead of writing out the whole expression, we can use

```
A XOR B
```

The table summarizing the XOR gate is shown below:

A	B	A XOR B
0	0	0
0	1	1
1	0	1
1	1	0

You'll notice that this table is similar to that for the OR gate except that when both A and B are 1, the result is a 0. What makes the XOR gate interesting is that it seems to add the two bits together.

When you're working with a couple of bits, you can add the two of them together

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■ **PC TUTOR**

as shown in the following examples:

```
  Ø    Ø    1    1
 +Ø   +1   +Ø   +1
---  ---  ---  ---
  Ø    1    1   1Ø
```

In the last example, the result is two bits long because of a carry bit. The rightmost digit in each example is the result of an XOR operation. Notice also that the carry bit is a result of an AND operation between the two bits. Thus, we can write formulas for the SUM bit (the rightmost digit) and the CARRY bit as follows:

```
  SUM = A XOR B
CARRY = A AND B
```

We're definitely on the right track. Now let's take a big step and add together two 4-bit numbers. We'll use 3 and 6 as an example. The addition (shown in both decimal and binary form) is shown below:

```
  3      ØØ11
+ 6    + Ø11Ø
---    ------
  9     1ØØ1
```

When we add multidigit binary numbers together, we start from the rightmost (least significant) pair of bits and proceed to the left, just as we do when we add together multidigit decimal numbers. However, we also have to take account of the various carry bits. When we add a pair of bits, we also have to add in the carry bit from the previous calculation. We'll call this the CARRY-IN bit. The calculation may also result in a bit to carry into the next calculation. We'll call this the CARRY-OUT bit. The CARRY-OUT bit from one calculation becomes the CARRY-IN bit for the next calculation.

Because of this carry bit, the formulas become a little more complex:

```
      SUM = (A XOR B) XOR (CARRY-IN)
CARRY-OUT = (A AND B) XOR ((A XOR B)
            AND (CARRY-IN))
```

Regardless of their increasing complexity, these formulas still involve only combinations of various logic gates that are built from transistors.

To do the full addition, you start with the rightmost pair of bits and do both calculations, then proceed to the next pair of bits to the left. If you want to verify that these formulas work for the calculation shown above, you can put together a table that shows the bits to be added, the SUM from each calculation, the CARRY-OUT from the calculation, and the CARRY-IN from the previous calculation:

```
CARRY-IN:   1   1   Ø   Ø
A:          Ø   Ø   1   1
B:          Ø   1   1   Ø
SUM:        1   Ø   Ø   1
CARRY-OUT:  Ø   1   1   Ø
```


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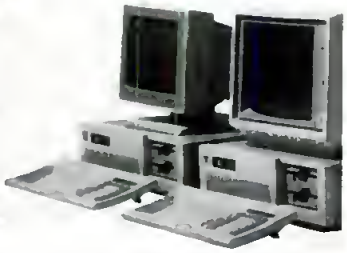

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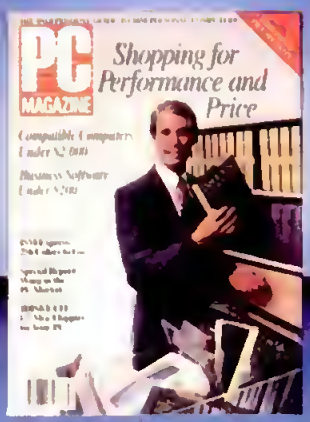

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■ PC TUTOR

Human beings may require several minutes to plug the bits into the formulas and determine the final result. Transistors do it in well under a millionth of a second. But don't feel bad. Human beings were required to "teach" the transistors how to add in the first place.

LOGICAL OPERATIONS *When programming in 8086/8088 assembly language, you can take advantage of the microprocessor's addition hardware using the ADD, ADC (add with carry), SUB (subtract), and SBB (subtract with borrow) instructions. Since everyone is familiar with addition and subtraction using numbers, these instructions present few problems, even for beginners.*

But the operations that are more fundamental to the inner architecture of the computer—the AND, OR, NOT, and XOR instructions—have a more tenuous connection with common life. You may say "I will take my umbrella if it looks as if it's going to rain AND I plan to be outside for a long time," but you'd be pretty weird if you sat down and drew up a little table of 0's and 1's to determine if an umbrella were indeed required for your excursion.

When you use the AND, OR, NOT, and XOR instructions in assembly language, they work on 8 or 16 bits at a shot. Let's look at some examples using 8-bit bytes. I'll be showing bytes in binary notation with a series of eight 0's and 1's. The Macro Assembler requires that a "B" follow such numbers.

Here's the first example:

```
MOV AL, 01100011B
NOT AL
```

The first statement moves the value 01100011B into register AL. The second statement performs a NOT operation on that register. After these two statements, the value of AL will be 10011100B. The NOT operator simply changes each 0 bit to a 1 and each 1 bit to a 0.

In these two statements, a value is moved into register AL and then the OR statement performs a logical OR operation between that byte and the byte 00110110B:

```
MOV AL, 01100011B
OR  AL, 00110110B
```


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■ PC TUTOR

After the second statement, the contents of the AL register will be 01110111B. Look at each pair of bits separately. The result is a 1 only if the bits in either the original value or the ORed value are 1. That's how we defined the OR logical operation earlier in the discussion.

These two statements do the same thing, except that they use the AND statement:

```
MOV AL, 01100011B
AND AL, 00110110B
```

The result in the AL register after performing the second statement is 00100010B. Once again, the instruction ANDed each pair of bits.

This is the XOR:

```
MOV AL, 01100011B
XOR AL, 00110110B
```

The result is 01010101B. I showed above how the XOR logical operator is used for addition. When you use an XOR statement in assembly language, however, it doesn't add the two bytes together because it doesn't take account of the carry bits. Each pair of bits is XORed independently of the others.

THE MASKED BIT *Assembly language programs often use various bits within the same byte or word to store several pieces of data. For instance, when the PC's BIOS stores information about the states of the shift keys (a subject discussed in PC Tutor, Volume 6 Number 4), it uses only one byte. Each of the shift keys can be either up or down, so only 1 bit is required to describe each key. While the PC BIOS could certainly use a separate byte to store the shift state for each key, that would be a waste of space.*

When working with bit-encoded data, the use of a "bit mask" is often helpful. This aids in determining the state of a particular bit.

For instance, suppose you have a byte stored in register AL and you want to determine whether the third bit from the right is a 0 or a 1. If the bit is a 0, you want to branch off to someplace else in the program. If the bit is a 1, you want to continue processing. The bit mask you would use is 00000100B. This byte has a 1 only in the third bit position from the right. You can

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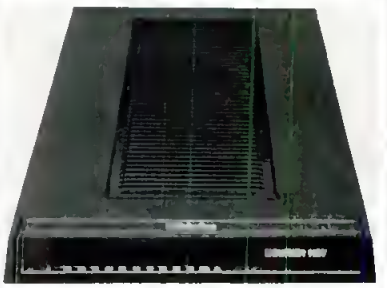

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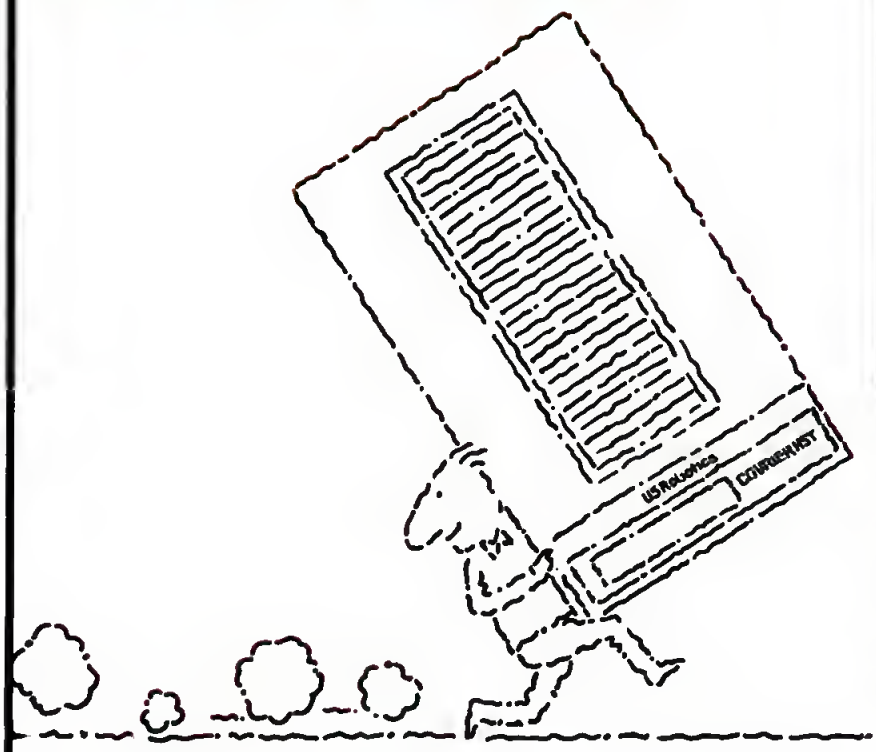

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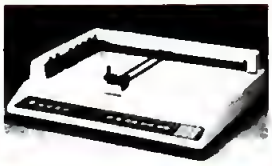

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■ PC TUTOR

use this bit mask in the following sequence of statements:

```
AND AL, 00000100B
JZ BitIsOff
```

When you perform a logical AND between the byte in AL and 00000100B, all the bits in AL are set to 0 except the 3rd bit from the right. The 3rd bit from the right remains unaltered. The Zero Flag would be set (and the program would branch) only if this bit were originally a 0.

Using the AND statement for this job has a little drawback, however—it destroys the value of the original byte in AL. To retain the original value of AL, you would instead use the TEST statement

```
TEST AL, 00000100B
JZ BitIsOff
```

This sets the Zero Flag if the third bit in AL is a 0 but doesn't destroy the original contents of the AL register.

You can also use logical operations to turn individual bits on or off. For instance, if you wanted to set the third bit in AL to 1, you would use

```
OR AL, 00000100B
```

All bits remain unaltered except the third bit from the right, which becomes a 1. Similarly, if you wanted to set the third bit to 0, you would use

```
AND AL, 11111011B
```

Again, all bits remain unaltered except the third bit from the right, which here becomes a 0. If you wanted to invert the state of the third bit (turn it from a 0 to a 1 or from a 1 to a 0), use this:

```
XOR AL, 00000100B
```

The ability of XOR to invert bits also makes it useful in some graphics video animation. The first XOR draws a figure on the display by inverting display bits. A second XOR reinverts the display bits, effectively erasing the figure and restoring the appearance of the original display.

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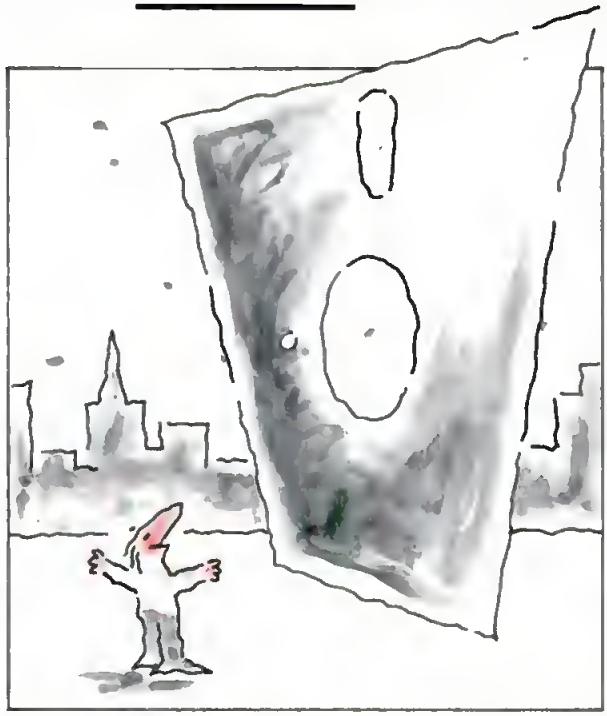

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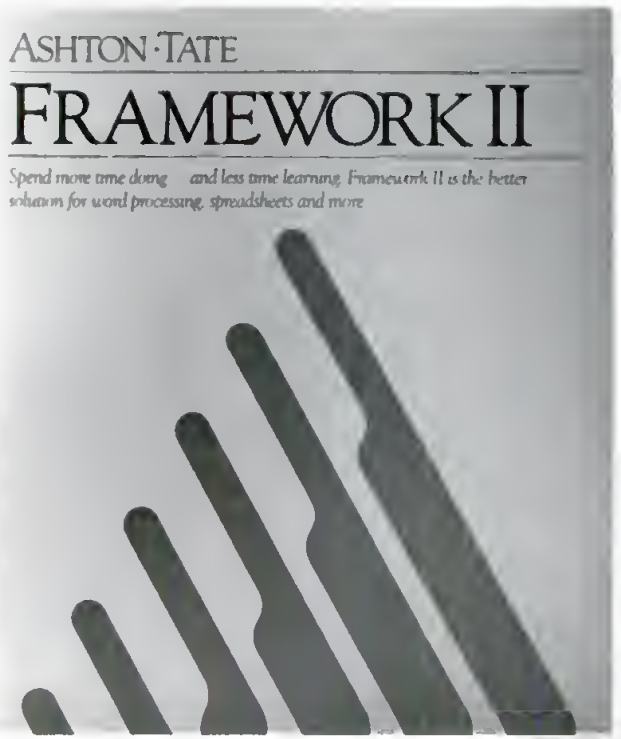

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State precisely what merchandise you want, specifying details such as model, make, size, component parts, etc.;

Confirm the price and expected delivery date as stated in the ad;

Indicate whether you will accept a substitute product if the item you ordered is unavailable, and, if not, that your payment should be returned;

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Keep a copy of your order and all other correspondence with the Seller. Your records should include the company's name, address and phone number; a description of the item ordered; your cancelled check or a copy of the money order; record of the date you mailed the order; and any sales slips and shipping receipts.

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Note the time and date of your conversation and the name of the person you talk with;

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Has there been an increase in the advertised price?

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What is the Seller's refund policy?

With whom should you correspond if there is a problem?

IF YOU HAVE PROBLEMS:

1. If you have not received your order as promised or if the item is defective, immediately notify the Seller in writing referring to your order by description, price, date, as well as by account number and order number, if available. Make sure you keep a copy of the letter.

2. If you complain by telephone, send a follow-up letter to confirm what was said.

3. If you think the merchandise is defective, reread your product instructions and your warranty carefully to be sure you don't expect features or performance the product isn't designed to give. Then contact the Seller for instructions. Don't return it to the Seller until you have been instructed to do so.

4. When returning merchandise make sure you keep the shipper's receipt or packing slip; your right to be reimbursed for postal cost is determined by store policy.

5. If you have completely discussed your problem with the Seller and are still not satisfied, write to the consumer complaint agency in the Seller's state. If you paid for the merchandise by credit card, you may have rights to withhold payment under a Federal law called the Fair Credit Billing Act.

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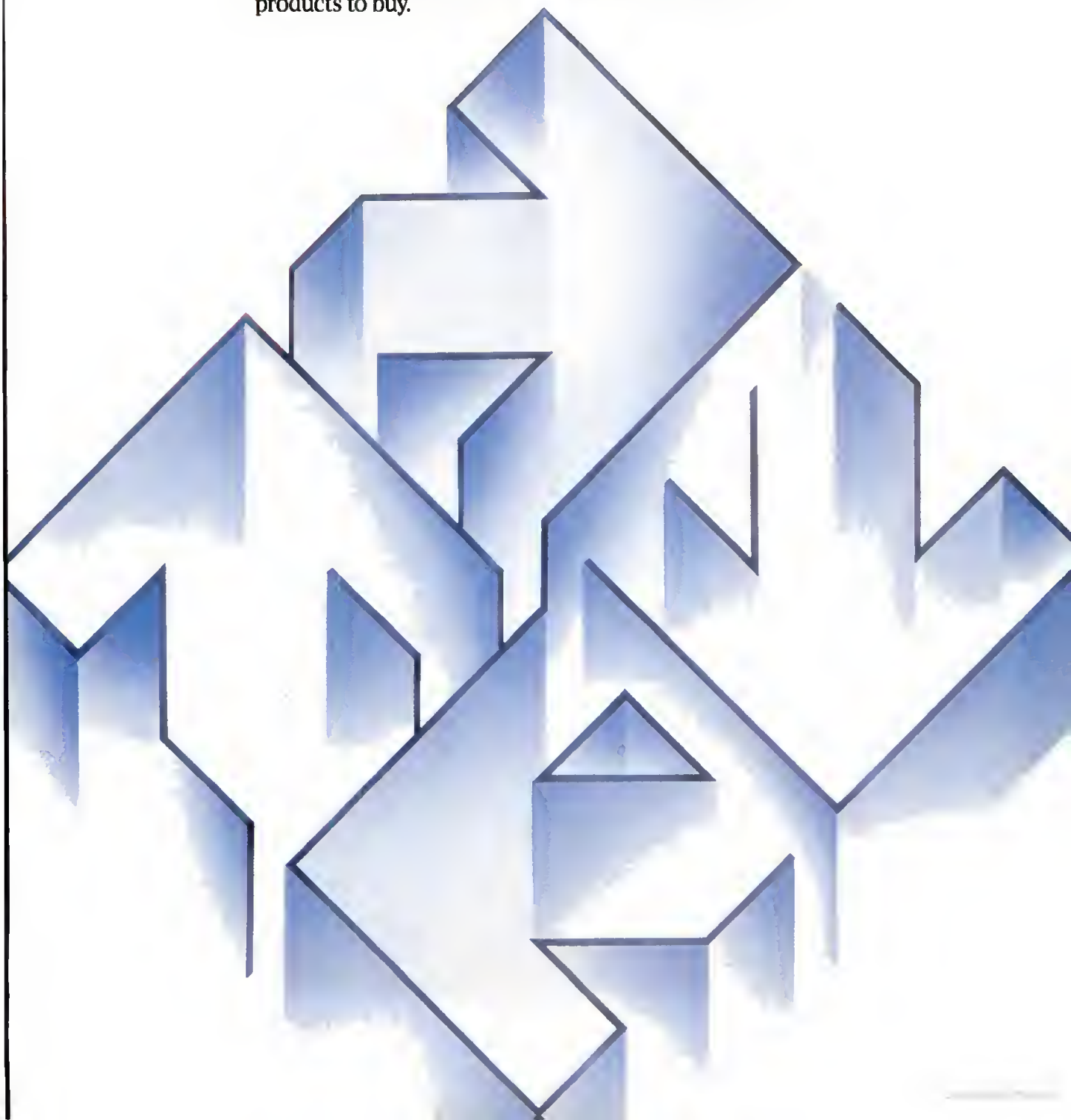

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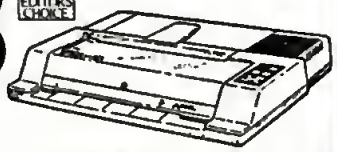

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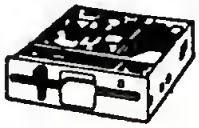

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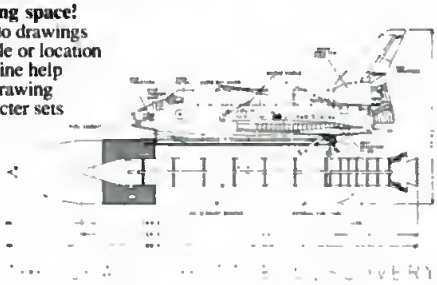

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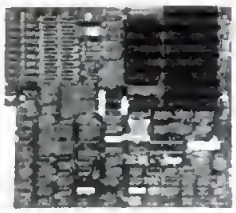

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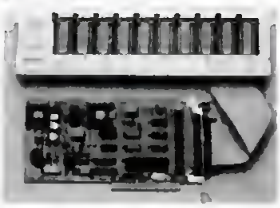

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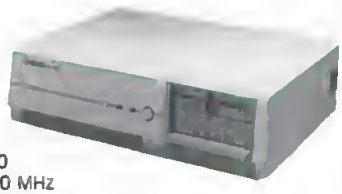

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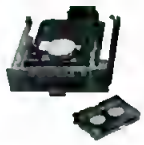

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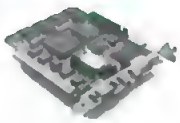

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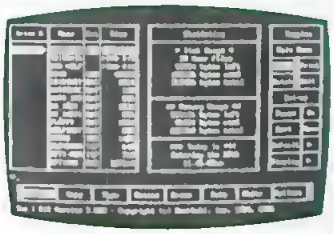

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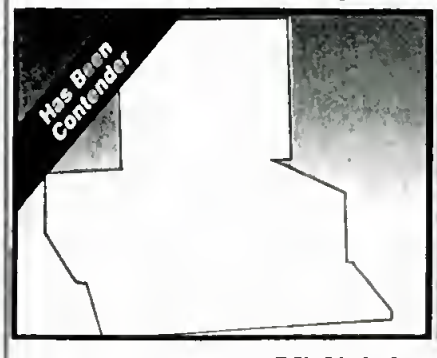

Features:	PC's Limited Turbo Monochrome System	VICTOR VPC II
	Not terribly fast	
	Not terribly cheap	
Manufacturer	A mail order house assembling imported parts	VICTOR...a 70 year old company backed by Datatronic ob, an international electronics giant. Manufactured by Kyocera of Japan.
8086 Compatible Microprocessor	No - slower 8088-2 with 8 bit bus	Yes - NEC V30 with 16 bit data bus
Hercules Compatible Graphics	Yes	Yes
640k	Yes	Yes
Monitor Included	Yes	Yes
101 Keyboard	No (84 Keys)	Yes
130 Watt Power Supply	Yes	Yes
Parallel Port	Yes	Yes
Serial Port (for modem)	No	Yes
MS-Dos 3.2 and GW-Basic	No ($95 extra)	Yes - No Extra Charge
Seagate ST-225 Hard Disk	No	Yes - The Best
Small Footprint Case	No (big and ugly)	Yes
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CIRCLE 355 ON READER SERVICE CARD

PC Magazine's Direct Marketing Connection

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PC MAGAZINE

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*Starch Study, July 1986

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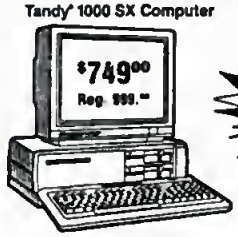

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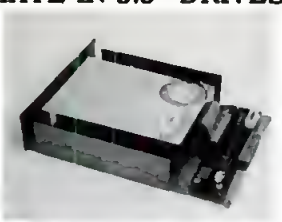

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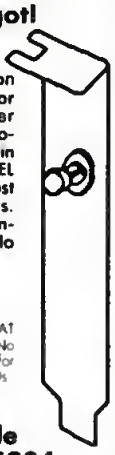

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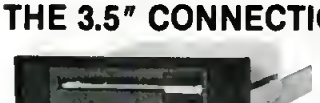

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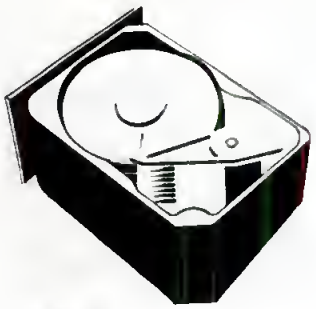

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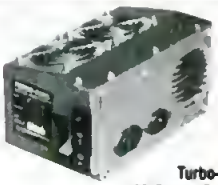

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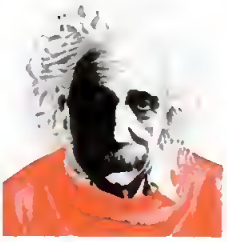

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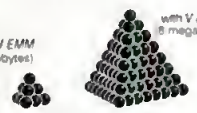

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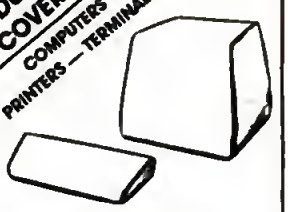

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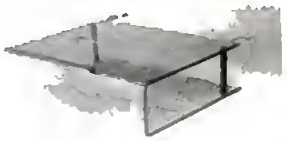

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a. ☐ Mainframe
b. ☐ Mini
c. ☐ PC
d. ☐ Printers/Plotters
e. ☐ Monitors
f. ☐ Terminals
g. ☐ Modems
h. ☐ Hard Disk/Tape Back-up
i. ☐ Add-in Boards
j. ☐ LANS
k. ☐ Micro-Mainframe Links

Software

l. ☐ Communications
m. ☐ Accounting
n. ☐ Spreadsheets/Financial Planners
o. ☐ Project Managers
p. ☐ Word Processors
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COMING UP

SPECIAL BUSINESS MANAGEMENT ISSUE Keeping the company books is always a challenge, especially if you've outgrown your accounting software, or worse, haven't any to begin with. Equally challenging are the questions that face business managers each day: Where do we locate an industrial waste site? A branch office? A new plant?

Reviews of nearly 60 accounting software packages will help you choose a program that effectively meets your accounting system needs. Backed by a team of 44 accounting consultants, under the technical guidance of the "Big Eight" accounting firm Price Waterhouse, *PC Magazine* examines the heart of each accounting system: the General Ledger, Accounts Payable, and Accounts Receivable modules. In addition, we'll detail the features and extras that show how well these accounting programs keep the books.

For easy reference, we've divided the accounting software into low-end, *dBASE*, and high-end categories. We'll also take a look at how and when you should use low-end programs like the $69.95 *Dac Easy Accounting*, programs like *Champion III* that can be customized with *dBASE*, or high-end programs like the $695-per-module *RealWorld Accounting System*.

ETHICS, NETWORKING, AND COMPUTERIZATION Contributing editors Jim Seymour, and Frank J. Derfler, Jr., and Price Waterhouse consultants G. William Dauphinais and Timothy J. Lee offer points that every growing business should consider when balancing the perspectives and interests of business management and accounting, installing a multiuser system, and computerizing operations.

EASING TOUGH CHOICES When the numbers are in and the proper course still isn't clear to you, a decision support package can help you find the best answer from a variety of options. To wrap up our special business management issue, contributing editor Jared Taylor and William Taylor, a consultant in artificial intelligence, examine ten of the top decision support packages available. PC

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CIRCLE 362 ON READER SERVICE CARD

AFTER HOURS

EDUCATION

A-PLUS: HELPS KIDS WITH HOMEWORK AND PC SKILLS

BY PEGGY GAVAN

Gone are the days when good grades alone measured a child's success in school.

Computer literacy, like "the new math" 20 years ago, is fast becoming a trend in the school curriculum, as parents and teachers encourage children to work with computers. *A-Plus (Easy Text and Graphics Solution)*, from Savtek Corp., is an integrated software program designed to help students learn the three R's while becoming comfortable with a computer.

A-Plus combines word processing, graphics, and simple DOS utilities into one easy-to-use package. Records and files graphically displayed as three-ring binders and index cards, oodles of icons, help lines for every function, and pop-up windows galore guide the novice user easily through the program. Experienced users can graduate to Ctrl-key sequences for faster command execution.

Although *A-Plus*'s word processor is modest, it does have some appropriate features for students, such as foreign language characters, a WYSIWYG screen, and a word-count function. In addition, users can import and export ASCII files to and from other word processors or integrate drawings and charts created with *A-Plus*'s graphics into their text files.

With *A-Plus*'s graphics capabilities, children can create freehand drawings or display and edit the clip-art drawings supplied with the program. The drawing commands are limited, but, as with the word processor, they are more than adequate for adding a graphic element to a book report, a term paper, or even an office memo.

In addition to creating text and graphics files, users can also copy, rename, delete, and display files from within the program. *A-Plus* also features an automatic file backup procedure for erased and revised files.

In a final effort to make the grade, *A-Plus* includes a pop-up clock with alarm and timer, a six-function calculator, and a calendar.

A-Plus can't guarantee a gold star on your children's homework papers, but it will help to make them feel at home with a computer. I give *A-Plus* a B minus.

List Price: *A-Plus*, $89.95.
Requires: 256K RAM; EGA, CGA, or compatible; one disk drive; DOS 2.0 or later. Not copy protected. Savtek Corp., P.O. Box 1077, Waltham, MA 02254; (617) 891-0638.

CIRCLE **687** ON READER SERVICE CARD

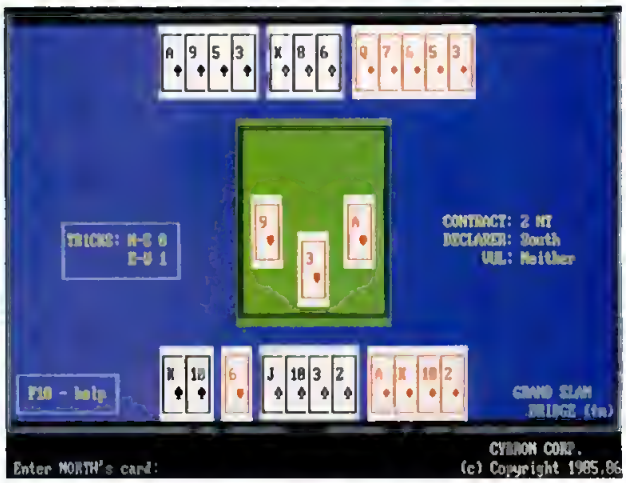
GAMES

GRAND SLAM BRIDGE KNOWS A BILLION POSSIBLE HANDS

BY RUSEL DE MARIA

Bridge fans, take heart. You'll never have trouble finding a bridge game again.

Grand Slam Bridge, from Electronic Arts, can provide as many partners as you need, up to four. Because the program's one billion possible hands are categorized, you can choose the kind of hand you want to play.



Grand Slam Bridge gives you many game options and up to four opponents.

You can choose from a menu that includes slam hands, opening two-bids, or no-trump contracts. You can assign cards or choose a particular contract hand (four hearts, for instance). To sharpen your instincts for game situations, choose a random hand. *Grand Slam Bridge* is loaded with options.

In fact, there are so many ways to set up the program that you may want to save your favorite profiles or set a particular profile as the default. See a particular hand that intrigues you? Save it to a file and play it again anytime.

Bidding follows the Stayman, Blackwood, Gerber, and Response to Unusual No-trump conventions. Unfortunately, you can't modify these conventions, but options are furnished for cue bidding, strong or weak two-bid systems, four- or five-card majors, and three levels of aggressiveness for computer players. You can also use *Grand Slam Bridge* to practice bidding strategies with your playing partner. Input is all from the keyboard, but the program makes automatic moves for you and responds to the minimum necessary input (for instance, if you only have one ace, hitting the A key automatically chooses that ace).

Special keys allow you to throw either your highest or your lowest card when following suit. In practice mode there are several levels of hints, ranging from showing the best move to offering hints on demand only. My favorite hint level prompts you only when your move differs from what the program would do. The program doesn't always give perfect advice, however. I improved my performance in some cases by ignoring the hints.

The only thing the program doesn't do is kick you under the table or provide refreshments.

List Price: *Grand Slam Bridge*, $59.95.
Requires: 256K RAM, CGA graphics. Copy protected (allows hard disk installation with key disk). Electronic Arts, 1820 Gateway Dr., San Mateo, CA 94404; (800) 448-8822.

CIRCLE **686** ON READER SERVICE CARD

Illustration: Mitch Rigie

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REVIEWS:
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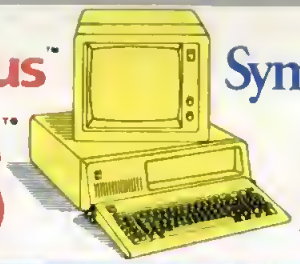

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COMPLETE TRANSACTION BOOKKEEPING

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CIRCLE 260 ON READER SERVICE CARD

AFTER HOURS

PERSONAL FINANCE

PETERSON'S FINANCIAL AID SERVICE: EXPENSIVE ADVICE FOR THE COLLEGE-BOUND

BY EDWARD MENDELSON

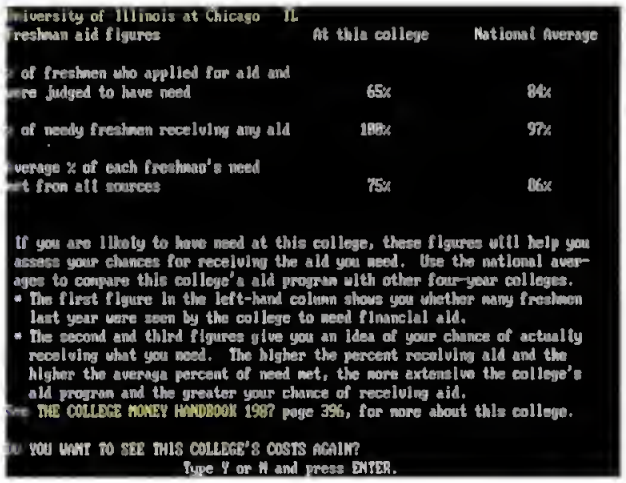
If you've got questions about college scholarships, you may be tempted to look into *Peterson's Financial Aid Service*, from Peterson's Guides. This $195 program estimates the amount of aid you'll need and gives advice on where to find it. But if the answers your children are writing on their high-school exams are anything like the answers this program gives you, you may never need to look at financial aid at all—they'll never get into college.

Two of the program's six sections are simple text screens that refer you to printed matter that comes in the box. Two other sections display average college costs in different parts of the country, as well as costs of individual colleges and the percentage of students who get scholarships. You can find the same information in any of a dozen paperbacks, but the program gives you the page numbers in the guide published by Peterson's Guides.

You get to interact with the two remaining sections. First you fill in a worksheet with the parents' finances, and the program calculates the amount you should expect to pay. (Peterson's Guides probably doesn't expect honest answers: the program is copy protected.)

No financial aid office will ever look at the resulting estimates. The real sums are set by organizations like the College Board. You can produce more-exact estimates using the worksheets in the Board's own *College Cast Book*.

Finally, you enter the student's income, ethnic group,



Peterson's Financial Aid Service *offers college financial-aid profiles.*

and activities, and the program scans its list of 350 private scholarships for the ones that suit you best. When I experimented by saying I was an Asian male with no military service, *Peterson's Financial Aid Service* suggested I apply to (among others) the United Negro College Fund and the Women Marines Association.

Maybe it's just as well that although it offered to print out these suggestions, it never did.

List Price: *Peterson's Financial Aid Service*, $195; $25 additional for hard disk version.

Requires: DOS 2.0 or later. Copy protected. Peterson's Guides Inc., Dept. 7001, P.O. Box 2123, Princeton, NJ 08543; (800) 225-0261.

CIRCLE **689** ON READER SERVICE CARD

COMMUNICATING

COMPUSERVE: A CHANCE TO CHAT AND SHOP

BY CHRISTOPHER JOHNSTON

PC communications can mean a lot more than sharing files with a mainframe. Like a friendly neighbor, CompuServe stands ready to share leisure-time games, utility software, and freewheeling conversations.

CompuServe Information Service's CB is much like its radio namesake in that you carry on disjointed line-at-a-time conversations on two "bands" of 36 "channels" each. Like real citizen's band radio, you assume a handle so nobody knows who you really are. This is especially important on band number 1—the adult channel. Sex talk aside, it's easy enough to find somebody on the general-purpose channels ready to discuss the intricacies of vegetarian cooking or to type a joke to. Enter GO CB at CompuServe's main menu and say howdy.

Free utility programs, games, personal opinions, and gossip galore are all in the IBM network, a loose collection of forums devoted to IBM-standard personal computers. The games are stored in the New User forum (type GO IBMNEW from the main menu). I used Xmodem to snag a copy of XWING.BAS in the games section of the New User forum, compiled it off-line with BAS .COM, and before long had a neat but cheap Star Wars game. I found both the latest version of ARC-E.COM (for compressing and restoring program files) and a set of utilities for my editor in the Software forum (GO IBMSW).

The Comp-U-Store feature is a more modern version of the 19th-century mail-order catalogs, but instead of supplies arriving months later on the Wells Fargo wagon, they arrive via UPS in a few weeks or overnight via Federal Express.

The centerpiece of Comp-U-Store is the electronic mall, in which goods such as nonperishable gourmet food, travel services, and liquor are peddled. Though there are some good deals, urban dwellers will find that most items are slightly more expensive than if you hunted for the best deal yourself. These deals make sense only if you're far from a store.

The novelty and convenience of shopping on-line is Comp-U-Store's advantage. Where else can you get live lobsters sent to you (at 14 for $189.95) without leaving your computer?

CompuServe's drawback is that it's expensive. During prime time, 300-bit-per-second access costs $12 per hour and 1,200 and 2,400 bps run $15 an hour. In order to make the billing process painless, CompuServe charges your credit card or withdraws money directly from your bank account. Unfortunately, this also makes it easier to incur staggering bills. With so many ways to occupy your spare time, CompuServe can be an addictive habit.

List Price: CompuServe, Startup package, $39.95 (includes $25 worth of free time). Connect rates are $12 per hour at 300 bps and $15 per hour at 1,200 and 2,400 bps.

Requires: Serial port, modem, communications software.

CompuServe Information Service Inc., 5000 Arlington Centre Blvd., P.O. Box 20212, Columbus, OH 43220; (614) 457-8600.

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PC MAGAZINE

AFTER HOURS

EDUCATION

RABBIT SERIES FROM THE LEARNING COMPANY: THE 3 Rs, ANIMATED

BY BILL MACHRONE
AND
STEPHANIE MACHRONE

While Apple, Atari, and Commodore certainly have more educational software available than IBM machines do, the list is growing. *Reader Rabbit* and *Writer Rabbit*, two popular elementary education programs, have been ported to the PC with great success.

Reader Rabbit teaches recognition of three-letter words and sharpens pattern-matching skills. It features lively screens, with rewards such as a dance performed by the eponymous rahhit.

My daughter, Stephanie, is a 5½-year-old kindergartener who taught herself to read, largely from playing with the computer at home. Here are her comments, verbatim:

"It's sometimes easy, but sometimes I mess up on it. I like Reader Rabbit, especially his dance. I like to put the words that don't match in the garbage can. I don't like the Word Train because it sometimes makes you use the same words over again and it gets boring. But it has good music. I hope lots of people buy this for their children, because it's very good."

Writer Rabbit concentrates on the parts of sentences: who, what, where, when, and why. It has games in which you identify the parts of sentences and are rewarded by building carrot cakes or ice cream cones. The Sentence Party is a completion game that lets children concoct zany stories from a narrative framework.

Here, again, are Stephanie's comments: "I like the Ice Cream Game. I like picking the parts of sentences. It taught me who, where, when, and what. I like the pictures and the blue background. The Silly Story Party is fun because I get to pick the parts of sentences. It's OK to pick the words that they have, but I like to type my own in when my ideas are funnier."

Each program has four games, and each game has options that allow you to set speed, difficulty, vocabulary, and variations. Stephanie's interest in them is spotty, as you might expect from a kindergartener. But she keeps coming back to *Reader Rabbit* and *Writer Rabbit*, a sure sign that there's substance behind the screens.

List Price: *Reader Rabbit* and *Writer Rabbit*, $39.95 each
Requires: CGA graphics, DOS 2.0 or later. Copy protected. The Learning Company, P.O. Box 2168, Menlo Park, CA 94026; (800) 852-2255; (800) 852-2256 in Calif.

CIRCLE **691** ON READER SERVICE CARD

Writer Rabbit *uses lively games to teach children sentence structure*

AFTER HOURS INDEX

READER RABBIT
WRITER RABBIT
Animated education for kids

SMART EYES
Speed reading made fun

PETERSON'S FINANCIAL AID SERVICE
College financial-aid help

COMPUSERVE
On-line services galore

A-PLUS
PC orientation for children

GRAND SLAM BRIDGE
A tireless bridge opponent

SELF-ENRICHMENT

$49.95 SMART EYES: BEYOND SPEED READING

BY DONALD P. WILLMOTT

Think of speed reading and you're likely to imagine someone sweeping a finger over text at an unbelievable rate. But this is the age of the PC, and now there is software like Addison-Wesley Publishing Co.'s *Smart Eyes* to teach improved reading speed and comprehension.

Smart Eyes divides its exercises into two categories: Reading Faster and Reading Smarter. The speed-reading exereises begin with entertaining eye calisthenics that involve following a dot as it dashes across the screen or identifying words that flash on and off.

Then, as feature articles from *The Christian Science Monitor* appear, you choose a speed (in words per minute) at which you'd like to read. Words can be erased, covered, or highlighted at the pace you have chosen. When you finish, you test your comprehension.

The Reading Smarter section offers exercises in rapid word and phrase recognition.

Smart Eyes records your scores so that your improvement can be tracked. Excellent documentation offers seven lesson plans, none of which involve more than 15 minutes a day over 6 weeks.

Smart Eyes has all the tools you need to train your eyes to read faster and your mind to read better. That it's fun too makes the package a winner.

List Price: *Smart Eyes*, $49.95.
Requires: DOS 2.0 or later. Copy protected. Addison-Wesley Publishing Co. Inc., One Jacob Way, Reading, MA 01867; (617) 944-3700.

CIRCLE **690** ON READER SERVICE CARD